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ABSTRACT

The grade 9-12 mathematics curriculum learning objectives, activities, monitoring procedures and resources for small schools were developed during 1978-79 through the cooperative efforts of 10 Snohomish and Island County school districts, Educational Service District 189 and the Washington State Office of Public Instruction. The objectives were correlated to the goals for the Washington Common Schools and to the Small Schools Program goals for mathematics and designed to aid in complying with Washington's Student Learning Objectives (SLO) Law. A limited number of activities were written for some areas of secondary mathematics since most instructors use a text as the basis for instruction. Included in the scope of the secondary mathematics curriculum were: computational and measurement skills (whole numbers and rational numbers): practical applications of mathematics (graphs, personal finances, ratio, proportion, measurement formulas, percent and use of calculators): elementary and advanced algebra: geometry: advanced topics (trigonometry, analytic geometry. logic, probability and statistics, matrices and determinants, sequences and series, polynomial function, vector theory, history of mathematics, and calculus): computer topics (computer literacy, hardware, flowcharting, Basic and Fortran languages): and general study techniques. (NEC)

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SMALL SCHOOLS

STUDENT LEARNING OBJECTIVES

RC012851

MATHEMATICS

GRADES 9-12

Dr. Frank B. Brouillet, State Superintendent of Public Instruction, Olympia, Washington

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SMALL SCHOOLS

MATHEMATICS CURRICULUM

9-12

Scope

Objectives

Activities

Resources

Monitoring Procedures

Working Copy

May 1979

This is a publication of the Instructional and Professional Services Division of the Superintendent of Public Instruction, Olympia, Washington.

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APPRECIATION

Many Educators have been involved in the development of the Small Schools curriculum materials. Of these, Robert Groeschell, now retired from the Office of the Superintendent of Public Instruction, deserves special recognition for his insight, leadership and support in initiating the Small Schools Curriculum Project.

In order to provide assistance to small school districts, a curriculum assessment was conducted by Mr. Groeschell in the spring of 1975. The findings of this assessment pointed out the need for the development of curriculum guidelines to assist small school districts in identifying learning objectives and in planning for program implementation. These findings served as a basis for originally funding the Small Schools Curriculum Project.

Dr. Don Hair, Dr. Monica Schmidt and Bill Radcliffe should be given recognition for their efforts in seeing that the project has continued from the original K-3 efforts to completion of guidelines 9-12.

Appreciation is also extended to Dr. Charles Murray, Superintendent, and the staff of ESD 189 for providing meeting space, equipment and resources which facilitated the development of the Small Schools Curriculum materials.

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INTRODUCTION

The Small Schools Project Objectives 9-12 were developed during the 1978-79 school year through the cooperative efforts of three levels of educational organization: ten Snohomish and Island County school districts, Educational Service District 189 and the State Office of Public Instruction. Funds were provided through Title IV C and SPI, with ESD providing in-kind services.

Process Procedure. ESD 189 personnel and selected curriculum specialists first identified objectives in three disciplines, language arts, mathematics and reading to serve as a basis for a goal based curriculum in the three disciplines. A cadre of secondary teachers from the ten consortium schools (Arlington, Darrington, Granite Falls, Lake Stevens, Lakewood, Monroe, Snohomish, Stanwood, Sultan and South Whidbey) then proceeded to use the objectives list as a base for curriculum development. The objectives listed in this document represent the final product of the curriculum specialists and secondary classroom teachers. The third step in the process was to involve secondary classroom teachers in writing activities to accompany the objectives. The objectives, and activities with these accompanying monitoring procedures and resources make up the curriculum guideline.

ORGANIZATION OF BOOK

Book Covers and Objective pages for Small Schools materials have been color coded for each subject with mathematics being blue.

Following each colored objective page there are usually several pages which identify activities, resources and monitoring procedures which may be used when teaching to the objective(s). (See pages viii and ix of this book for more detailed explanation of the format.) Within each curriculum book the objectives have been correlated to the Goals for the Washington Common Schools and to the Small Schools Program goals for mathmatics. A limited number of activities have been written for some areas of the scope of secondary mathematics, since most instructors use the the text as the basis for instruction. Users of this material are asked to suggest activities that might be added to this book following its field testing and prior to final printing.

RELATIONSHIP TO THE SLO LAW

The purpose of this book and all other Small Schools materials is to assist teachers with the improvement of curriculum and instruction. In addition, it is expected that many smaller districts lacking curriculum personnel will find this book helpful in complying with the SLO Law. (This law requires districts to identify student learning objectives grades nine through twelve in the area of language arts, reading and mathematics and initiate implementation of such a program on or before September 1, 1981.)*

Contained within this book are many more objectives than any district would choose to identify as their SLO objectives.

The approach of the Small Schools Project Consortium was first to develop a curriculum, grades 9-12, in mathematics, language arts and reading using a goal base model. Thus the objectives contained in this book, although they may be helpful in meeting the intent of the law, were really designed as instructional objectives and not specifically for the SLO Law. The consortium also made a decision to develop a taxonomy of objectives for each discipline 9-12 and deliberately chose not to develop objectives for specific courses. Secondary teachers thus are free to choose objectives from the taxonomy to build their specific courses in the discipline.

*See "Guide to the Student Learning Objectives Law," RCW 28A. 58.090
SPI, Olympia, Washington 98504.

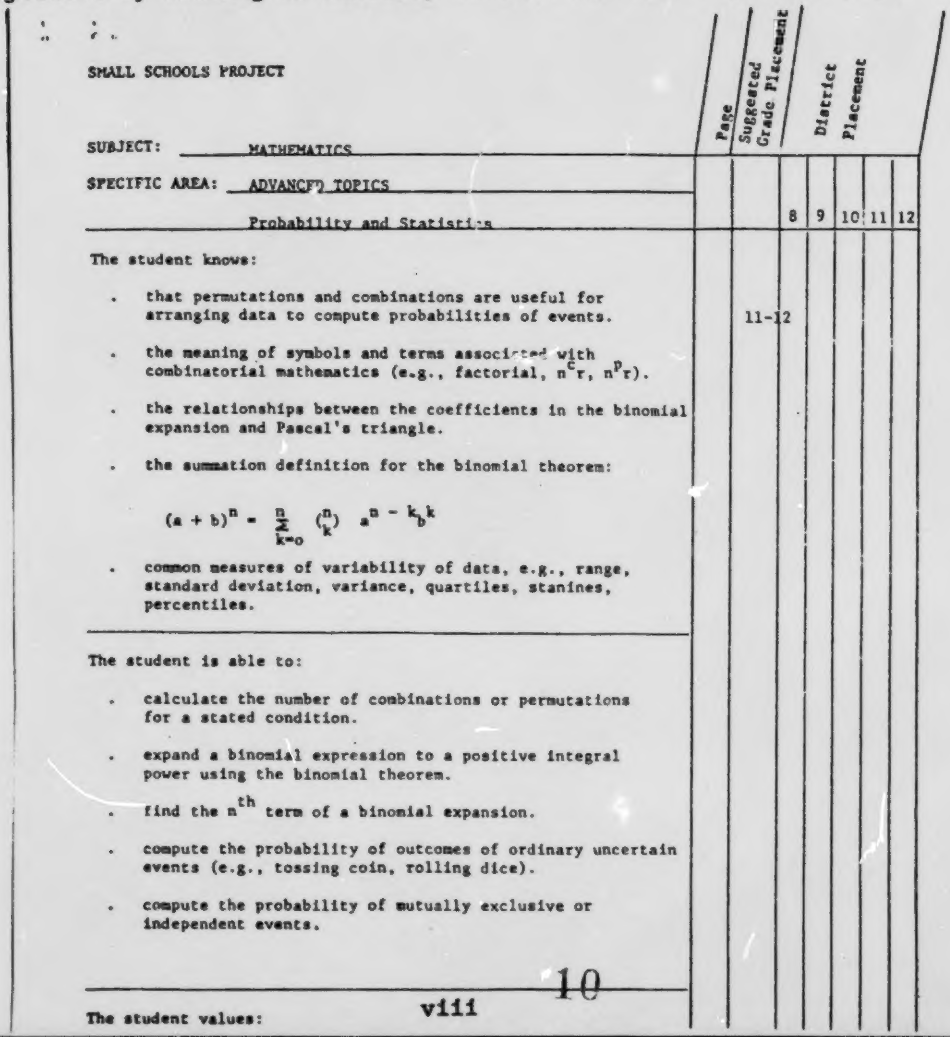
FORMAT

One unique feature of the Small Schools Curriculum is the format or arrangement of information on the page. The format was developed in order to facilitate the transportability of the product by allowing districts to personalize the curriculum materials to meet their own educational programs. The Small Schools Format provides a simple arrangement for listing objectives and identifying activities, monitoring procedures, and resources used in teaching.

Page One

The first format page lists the sequence of student learning objectives related to a specific area of the curriculum for either reading, language arts, mathematics, science or social studies. For each objective a grade placement has been recommended indicating where each objective should be taught and mastered. The grade recommendation for the secondary level is very broad reflecting that courses are often non-graded or that students must enroll in some basic courses to meet graduation or compentencies requirements.

Columns at the right of the page have been provided so district personnel can indicate the grade placement of objectives to coincide with the curriculum courses in their schools. District personnel may also choose to delete an objective by striking it from the list or add another objective by writing it directly on the sequenced objective page.



SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Probability and Statistics

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
• that permutations and combinations are useful for arranging data to compute probabilities of events.		11-12					
• the meaning of symbols and terms associated with combinatorial mathematics (e.g., factorial, n^cr, n^pr).							
• the relationships between the coefficients in the binomial expansion and Pascal's triangle.							
• the summation definition for the binomial theorem: $(a + b)^n = \sum_{k=o}^{n} \binom{n}{k} a^{n-k}b^k$							
• common measures of variability of data, e.g., range, standard deviation, variance, quartiles, stanines, percentiles.							
The student is able to:							
• calculate the number of combinations or permutations for a stated condition.							
• expand a binomial expression to a positive integral power using the binomial theorem.							
• find the n^{th} term of a binomial expansion.							
• compute the probability of outcomes of ordinary uncertain events (e.g., tossing coin, rolling dice).							
• compute the probability of mutually exclusive or independent events.							
The student values:							

Page Two

On the second format page, one or more objectives from the first format page are rewritten and suggested activities, monitoring procedures and possible resources used in teaching to the objective(s) are identified. The objectives are correlated to the State Goals for Washington Common Schools and to broad K-12 program goals. The suggested grade placement of the objectives and the activities is indicated and, wherever applicable, the relatedness of an objective to other curriculum areas have been shown. Particular effort has been given to correlating the materials with the areas of Environmental Education, and the use of the newspaper in the classroom.

Below is an example of a completed second format page. Teachers and principals in local districts may personalize this page by listing their own resources and by correlating their district goals to the student learning objectives.

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to compute the probability of outcome of ordinary uncertain events (e.g., tossing coin, rolling dice).

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Dice Probability
Group Size: 3 students
Materials: Pairs of dice - one red and the other white.

Procedure(s):

. Have the students roll a pair of dice 36 times and record their results. Compare results with:

		1	2	3	4	5	6	Red
White	1	2	3	4	5	6	7	
	2	3	4	5	6	7	8	
	3	4	5	6	7	8	9	
	4	5	6	7	8	9	10	
	5	6	7	8	9	10	11	
	6	7	8	9	10	11	12	

e.g., Dice roll results in Red 3, White 2. Student crosses out 5 in the following position:

		1	2	3	4	5	6	Red
White	1	2	3	4	5	6	7	
	2	3	4	~~5~~	6	7	8	
	3	4	5	6	7	8	9	
	4	5	6	7	8	9	10	
	5	6	7	8	9	10	11	
	6	7	8	9	10	11	12	

Suggested Monitoring Procedures

Teacher observation

Possible Resources

Probability and Statistics
Summer Workshop 1976
Washington State Superintendent
of Public Instruction

District Resources

DEFINITION OF FORMAT TERMS
Small Schools Curriculum Project

Subject indicates a broad course of study. The subject classifies the learning into one of the general areas of the curriculum, i.e., reading, mathematics, social studies.

Specific Area indicates a particular learning category contained within the subject. Within the subject of reading there exist several specific areas, i.e., comprehension, study skills, word attack skills.

State Goal indicates a broad term policy statement relating to the education of all students within the State of Washington. In 1972, the State Board of Education adopted 10 State Goals for the Washington Common Schools.

District Goal generally reflects the expectations of the community regarding the kinds of learning that should result from school experience. These goals are employed mainly to inform the citizenry of the broad aims of the school. When district goals are correlated to student learning objectives, community members are able to see how their expectations for schools are translated daily into the teaching/learning process of the classroom.

Program Goals are K-12 goals which do not specify grade placement. These goals provide the basis for generating subgoals or objectives for courses or units of study within a subject area. Program goals are used as a basis for defining the outcomes of an entire area of instruction such as mathematics, language arts or social studies.

Student Learning Objectives

Three major types of learning objectives which have been identified are knowledge, process and value objectives.

Knowledge Student Learning Objectives identify something that is to be known and begins with the words, "The student knows.. ". Knowledge objectives specify the knowledge a student is expected to learn. These objectives include categories of learning such as specific facts, principles and laws, simple generalizations, similarities and differences, etc.

An example of a Knowledge Student Learning Objective is: "The student knows guide words in a dictionary indicate the first and last words on the page."

Process Student Learning Objectives identify something the student is able to do, and begins with the words, "The student is able to...". These objectives are associated with the rational thinking processes of communication, inquiry, problem solving, production, service and human relationships.

An example of a Process Student Learning Objective is: "The student is able to associate a consonant sound with the letter name."

Value Student Learning Objectives identify only the type of values which foster the context of the discipline. These objectives are thought to be most uniformly and consistently approved by society as supporting the major aims of the discipline.

An example of a Value Student Learning Objective is: The student values the role of plants in his/her daily life."

Suggested Learning Activities describe the behavior of both the teacher and students. The instructional strategies employed by the teacher, as well as the activities undertaken by the students, are included in this section. Each activity includes materials, group size and procedures.

Suggested Monitoring Procedures indicate informal methods for determining the progress a student is making towards the attainment of the objective. These methods include techniques such as teacher observation, student interest and attitude surveys and recording results of classroom instruction.

Possible Learning Resources indicate materials, teacher-made or commercially produced, which are needed by both the teacher and students in order to accomplish the learning activities.

GOALS FOR THE WASHINGTON COMMON SCHOOLS

1. As a result of the process of education, all students should have the basic skills and knowledge necessary to seek information, to present ideas, to listen to and interact with others, and to use judgment and imagination in perceiving and resolving problems.

2. As a result of the process of education, all students should understand the elements of their physical and emotional well-being.

3. As a result of the process of education, all students should know the basic principles of the American democratic heritage.

4. As a result of the process of education, all students should appreciate the wonders of the natural world, human achievements and failures, dreams and capabilities.

5. As a result of the process of education, all students should clarify their basic values and develop a commitment to act upon these values within the framework of their rights and responsibilities as participants in the democratic process.

6. As a result of the process of education, all students should interact with people of different cultures, races, generations, and life styles with significant rapport.

7. As a result of the process of education, all students should participate in social, political, economic, and family activities with the confidence that their actions make a difference.

8. As a result of the process of education, all students should be prepared for their next career steps.

9. As a result of the process of education, all students should use leisure time in positive and satisfying ways.

10. As a result of the process of education, all students should be committed to life-long learning and personal growth.

MATHEMATICS PROGRAM GOALS
(K-12)

1. The student values the study of mathematics for its usefulness and application to everyday life.
2. The student develops the ability to communicate with precision and confidence using the vocabulary and symbols unique to mathematics.
3. The student develops the concept of number and numeration including counting, place value, reading and writing numbers, various numbering systems, number theory and scientific notation.
4. The student develops general mathematical concepts of time-space relationships; equality-inequality; measurement; function; graphs, charts and tables; probability and statistics; and geometry.
5. The student develops accuracy in using the computational skills of adding, subtracting, multiplying and dividing.
6. The student develops the ability to use problem-solving techniques.
7. The student develops the knowledge and use of the structure of mathematical systems and real numbers.
8. The student knows and is able to use the symbols, elements, operations and structure of the following number systems: whole numbers, integers, rational numbers, real numbers and complex numbers.

MATHEMATICS

SCOPE
9-12

I. COMPUTATIONAL AND MEASUREMENT SKILLS

Whole Numbers.. 1
    Place Value.. 1
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SMALL SCHOOLS PROJECT

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
SUBJECT: MATHEMATICS							
SPECIFIC AREA: COMPUTATIONAL SKILLS Whole Numbers: Place Value							
The student knows:							
. place value through billions in base ten numeration.	3-4	REVIEW 9 - 12					
The student is able to:							
. read and write whole numbers up to billions.	3-4						
. round numbers to the nearest ten, hundred, thousand, million, billion.	3-4						
The student values:							

SMALL SC[illegible]S PROJECT - Working Copy

Suggested Objective Placement 9

Student Learning Objective(s) A. The student knows place value through billions in base ten numeration. B. The student is able to read and write whole numbers up to billions.

C. The student is able to round numbers to the nearest ten hundred, thousand, million, and billion.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,3

Suggested Activities: Grade(s) 9

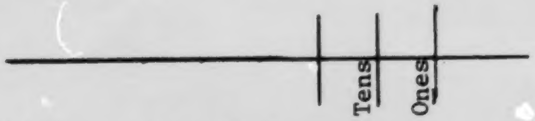
Title: Place Value

Group Size: small group or entire class

Materials: chalkboard or worksheet

Procedure(s):

- Begin a place value chart on the chalkboard or duplicate one for each student



- Have students extend chart.
- Have students write numbers through billions by telling them the place value of each digit. e.g., five in the hundred's place, two in the ones place would be 502.

Suggested Monitoring Procedures

Observe class

Possible Resources

District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
Title: Unblank the Blank **Group Size:** Individual, entire class **Materials:** Worksheet **Procedure(s):** • See page 45 for explanation of procedures	Observation Quiz	
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

	Page	Suggested Grade Placement	District Placement				
Whole Numbers: Addition / Subtraction			8	9	10	11	12
The student knows:							
. and maintains knowledges, skills and basic facts of addition and subtraction (see Mathematics, Addition, K-8).	7 14	9-12					
. subtraction is the inverse of addition.							
The student is able to:							
. complete any addition and subtraction problem in horizontal or vertical form.	9-14						
. solve word problems involving addition and subtraction of whole numbers.	15 16						
. check subtraction problems by addition.							
The student values:							
. the quick and accurate recall of addition and subtraction facts.							

SMALL SC[illegible]S PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student knows and maintains knowledges, skills and basic facts of addition and subtraction.

Related Area(s)

State Goal	1,8
District Goal	
Program Goal	2,3,5

Suggested Activities: Grade(s) 9

Title: Estimating Sums
Group Size: small group
Materials: chalkboard, worksheet

Procedure(s):

- Ask the group if there are situations in life when it might be important to estimate an answer in adding. Help students to elicit responses such as shopping, telling time, estimating distance, mileage, etc.
- Put several examples on the board, and have students work the problems as a group using the terms "greater than" and "less than."
- Give students additional examples on a worksheet. Have the students circle their estimated answer, then work the problem as a check.

Example(s):

$4821 + 190 > 5000$ or < 5100
$284 + 990 > 1100$ or < 1300

Suggested Monitoring Procedures

Worksheet of addition problems to check combinations that pose problems. Group students for reteaching.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 Page 5

District Resources

The previous numbered page in the original document was blank.

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows and maintains knowledges, skills and basic facts of addition and subtraction. B. The student is able to complete any addition and subtraction problem.

State Goal	1
District Goal	
Program Goal	5

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Magic Squares
Group Size: Entire class
Materials: Magic Squares

Procedure(s):

- Remind students that in each magic square each column, row, and diagonal have the same sum. Example:

8	3	4
1	5	9
6	7	2

- Complete the magic squares below:

2		6
9		
4	3	

Suggested Monitoring Procedures

Observation of daily work.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 Page 5

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources
30		31

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9

Student Learning Objective(s) A. The student knows and maintains basic facts of addition and subtraction. B. The student is able to complete any addition or subtraction problem in either horizontal or vertical form.

State Goal	1
District Goal	
Program Goal	5

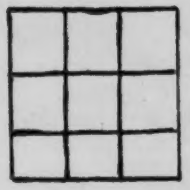
Related Area(s)

Suggested Activities: Grade(s) 9

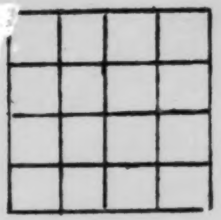
Title: Anti-Magic Square
Group Size: entire class
Materials: magic square blanks

Procedure(s):

- Each row, column, and the two diagonals must add to a different number.
- Use each of the humbers 1-9 exactly once to build an anti-magic square.



- Now for the champions only. Build a 4 by 4 anti-magic square using each of the whole numbers from 1 to 16 exactly once. It can be done.



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Suggested Monitoring Procedures

Observe class.
Give short quiz and regroup students needing assistance.

Possible Resources

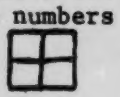
See Small Schools Mathematics Curriculum Grades 7-8
Pages 12, 13, 15, 16, 19, 25, 39

District Resources

Suggested Activities: Grade(s) ______

Procedure(s): (Continued)

- It is possible to build a two by two anti-magic square using only the numbers 1, 2, 3, and 4 each exactly once?



Title: Bingo
Group Size: entire class
Materials: lank Bingo score cards

Procedure(s):

- Have students fill out Bingo score cards with supplied numbers, using between 25-50 different numbers.
- Read orally or write the problem on the chalkboard or read it orally to the class
- Students use their answers to fill in boxes.
- The first student to Bingo with correct numbers is the winner.

Suggested Monitoring Procedures

Observe class while calling out problems.

Possible Resources

See Small Schools Project
Mathematics Curriculum
Grades 7-8
Pages 6, 9, 10, 15, 19, 25, 39.

District Resources

SMALL SCH PROJECT - Working Copy

Suggested Objective Placement 9

Student Learning Objective(s) A. The student knows and maintains basic facts of addition and subtraction. B. The student is able to complete any addition or subtraction problem in either horizontal or vertical form.

State Goal	1
District Goal	
Program Goal	5

Related Area(s)

Suggested Activities: Grade(s) 9

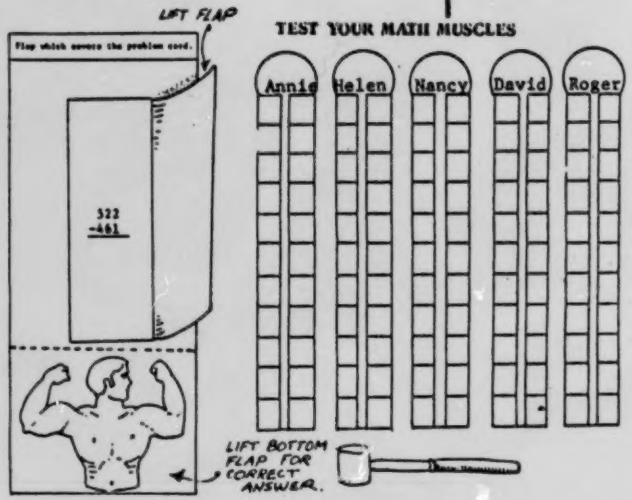
Title: Test Your Math Muscles
Group Size: small groups
Materials: gameboard, markers, worksheet, paper, pencil

Procedure(s):

- One student in the small group does not compete with the others. Instead, he/she chooses the problem to be worked and inserts the card with that problem written on it under the problem holder (see illustration). The answer is written at the bottom of the problem card so that it is visible when the flap with the Muscle Man picture is lifted.
- The problem is concealed from the others until the selector says go.
- The other students solve the problem. They may or may not copy the problem.
- As the students finish, they put their pencils down and place their writing hand on top of their heads.
- The player who is the selector checks the answers.
- The first player to finish correctly advances one space toward ringing the bell.

Suggested Monitoring Procedures

Worksheet with subtraction problems. Ask students to check by using addition. Re-group students having difficulty.


LIFT FLAP
Flap which covers the problem card.
322
-461
TEST YOUR MATH MUSCLES
Annie
Helen
Nancy
David
Roger
LIFT BOTTOM FLAP FOR CORRECT ANSWER.

Possible Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to solve word problems involving addition and subtraction of whole numbers.

State Goal 1

District Goal

Program Goal 6

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Move On

Group Size: Small groups (two to six each)

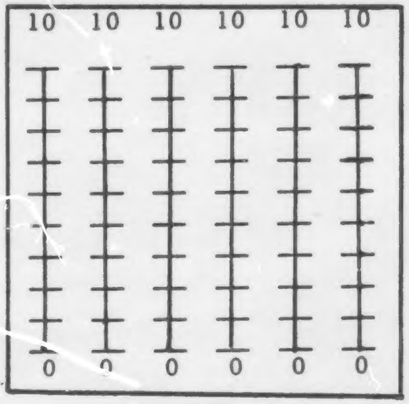
Materials: Game board, six problem folders (containing 30 numbered problems each), answer card for each folder, markers (one per student), spinner marked 1-30.

Procedure(s):

- Each student in the group draws a problem folder and another student takes his/her answer card.
- In turn they spin the spinner and work the problem indicated (no repeats).
- Score +1 point for correct answer, -2 for incorrect answer. Move the appropriate number of spaces for each spin and answer.
- First person scoring ten wins.

Example:

Game Board



Suggested Monitoring Procedures

Observation

Quiz

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 Page 5

District Resources

Suggested Activities: Grade(s) ______

Title: Story Problem Competition
Group Size: Entire class
Materials:

Procedure(s):

- Divide class into groups or teams of four students each. Each team should be assigned the task of developing one story problem for each of the four operations (+, -, x,), In addition they provide a number sentence and solution for the teacher. Groups then exchange problems only. Have a timed contest for finding a number sentence and a solution.

Title: Number Sentence Completion
Group Size: Small group, entire class
Materials: Worksheet, chalkboard

Procedure(s):

- Give students several problems verbally and have them suggest number sentences to solve problems.
- Put these on the board and solve.
- Give students a worksheet with similar problems to solve.

Example: Study each word sentence, then write a number sentence and solve.

. Six less than a number when the number is sixty-four	64-6 =
. Six more than a number when the number is eighty-one	6+81 =
. Four times a number when the number is one hundred four	104x4 =
. Five minus a number when the number is two hundred eighty three	283-5 =

Complete:

. A number minus five when the number is ....

Suggested Monitoring Procedures

Give students a worksheet with word sentences and have them translate to number sentences with correct operational signs.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 pages 33-39

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

Whole Numbers: Multiplication

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. a factor is one of two or more quantities having a designated product.		REVIEW 9 - 12					
. a product results when two numbers are multiplied.	19-22						
. the product of any number multiplied by the factor of zero is zero (6 x 0 = 0).							
. the product of any number multiplied by the factor of one is that number (3 x 1 = 3).							
. the multiplication facts with products through 81 (mastery).							
The student is able to:							
. multiply any number by any number.							
. multiply by 10's, 100's, 1,000's.							
. solve word problems using multiplication.							
The student values:							
. the quick and accurate recall of multiplication facts.	23						

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

State Goal	1
District Goal	
Program Goal	2,7,8

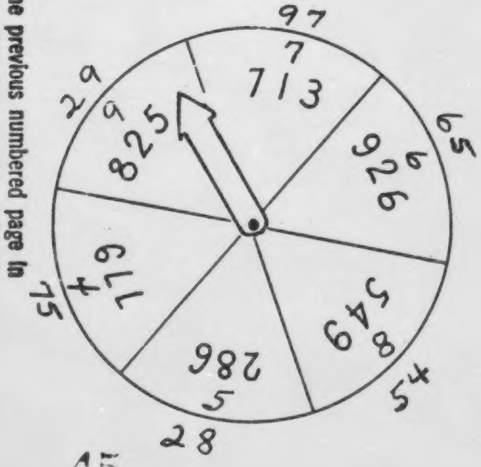
Student Learning Objective(s) A. The student knows a product results when two numbers are multiplied. B. The student is able to multiply any number by any number.

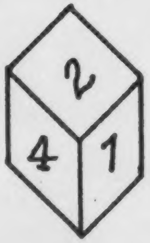
Related Area(s)

Suggested Activities: Grade(s) 9	Suggested Monitoring Procedures	Possible Resources
Title: Spin Factors **Group Size:** Pairs, small group **Materials:** 1 die marked 2-7, spinner cards (see illustration), spinner, paper and pencil	Observe class	See Small Schools Mathematics Curriculum Grades 7-8 Page 15

Procedure(s):

- Players, in turn, roll the die to see how many factors they must spin.
- The spinner is spun the number of times the die indicates, and the players write down the factors.
- The resulting problem is then solved.
- Players check each other's work.
- One point if correct; thirteen wins.





District Resources

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Suggested Activities: Grade(s) ______

Title: Multo
Group Size: Small group, entire class
Materials: Card for each player, markers, master card for teacher (with all possible combinations). Note: 1" graph paper works well for the cards.

Procedure(s):

- Pass out cards to each student and enough markers to play a game.
- The rules are those of Bingo. The student card has five rows of five squares. The center square is a free square. Each square has the product of two numbers.
  Example: 42, product of 6 x 7
- The tables are divided up with the 0's and 1's under M, 2's and 3's under U, 4's and 5's under L, 6's and 7's under T, and 8's and 9's under O.
- The teacher calls out, "Under L, 6x7," and so on.

M	U	L	T	O
1	6	20	42	64
8	9	10	36	81
0	3	FREE	49	32
7	4	15	18	9
6	16	12	14	18

Suggested Monitoring Procedures

Note the consistent winners. Award prizes to winners.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 Page 15

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student knows multiplication facts with products through 81 (mastery).

State Goal	1
District Goal	
Program Goal	2,7,8

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Multiplication Relay
Group Size: Entire class
Materials: Index cards with positive and negative integers on them

Procedure(s):

- Form two teams and give each team a pile of cards.
- The first player picks two cards and multiplies them on the board.
- He/She then tags the next team member who picks a card, multiplies it to the previous product, etc.
- Give the first team to finish, 3 points.
- Give 5 points for each time a product was correct.

Variation:

- The division process may be used instead of multiplication.
- In division draw 2 cards each time and do not use the previous quotient.

Title: Multiplication Bingo
Group Size: Entire class
Materials: Spinner, dice

Procedure(s):

- Each student makes a 5x5 Bingo card on paper.
- In the boxes write any whole number from -0 to 81 omitting 0, 1 and all prime numbers.
- The teacher either picks two single-digit whole numbers or uses a spinner or special dice.
- The student multiplies those two numbers together and x's out the answer if it appears on his/her card.

Suggested Monitoring Procedures

Teacher observation. Note students having difficulty, diagnose problem and reteach if necessary.

Short quiz periodically.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 Pages 6, 8, 9, 10, 12, 13, 19, 25, 40

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
51		52

SMALL SCHO[illegible] PROJECT - Working Copy

Suggested Objective Placement 9 - 1

Student Learning Objective(s) The student values the quick and accurate recall of multiplication facts.

State Goal	1
District Goal	
Program Goal	5,8

Related Area(s)

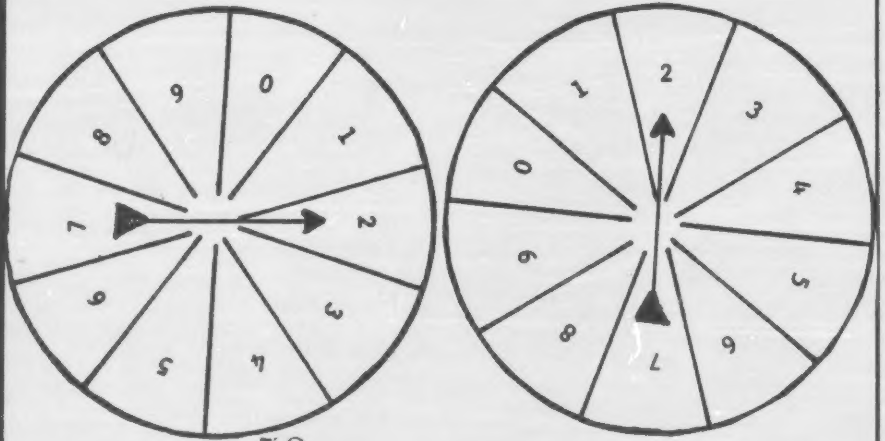
Suggested Activities: Grade(s) 9

Title: Spin-a-Fact
Group Size: pairs, small groups
Materials: one gameboard and two markers per student, two spinners per group

Procedure(s):

- The students spin, in turn, both spinners and multiply the two indicated numbers.
- The student then finds the product on the point award chart (found on back of page) to learn points earned.
- The students keep track of score on tally sheet.
- The winner is the first student to earn 100 points.

Example of spinners: (Game needs two spinners).



Suggested Monitoring Procedures

Timed fact test.

Observe games.

Possible Resources

Math Laboratory at the Pacific Science Center, Seattle, WA.

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
55		56

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

	Page	Suggested Grade Placement	District Placement				
Whole Numbers: Division			8	9	10	11	12
The student knows:							
. that division is the inverse of multiplication.		REVIEW					
. division is repeated subtraction.		9 - 12					
. a dividend is a quantity to be divided.							
. a divisor is the quantity by which the dividend is to be divided.							
. the quotient is the quantity resulting from division of one quantity by another.							
. the remainder is the dividend minus the product of the divisor and the quotient.							
. basic division facts (mastery).	27						
The student is able to:							
. divide two, three and four digit numbers by one, two or three digit numbers with or without remainders expressed as whole numbers.							
. divide two, three and four digit numbers by one, two or three digit numbers with or without remainders expressed as fractions or decimals.							
. check a division problem by using multiplication.	27						
. estimate the quotient in a given division problem.	27						
. solve word problems involving division.	27						
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows basic division facts (mastery). B. The student is able to solve word problems involving division. C. The student is able to check a division problem by using multiplication. D. The studentis able to estimate the quotient in a given division problem.

State Goal	1
District Goal	
Program Goal	2,5,6

Related Area(s)

Suggested Activities: Grade(s) 9	Suggested Monitoring Procedures	Possible Resources
Title: Division Challenge **Group Size:** Small group, entire class **Materials:** Chalkboard and chalk **Procedure(s):** . Prepare a variety of division problems with answers, i.e., multiple digit problems with and without remainders. . Pick a student to begin and have him call on someone to challenge him/her. . Teacher gives a problem, first one finished with the correct answer wins and continues to challenge. . Three challenges without a loss retires the champ until later. . When all students have had a change (give losers another chance against each other), have the champions go against each other until a final winner is found.	Students with little success can be given supplemental activities after the game is completed.	District adopted text. **See Small Schools Mathematics Curriculum Grades 7-8 Pages 6,9,10,12,13,15,25,40**
		District Resources
Title: Secret Code **Group Size:** Entire class **Materials:** Paper, pencil **Procedure(s):** . Teacher makes up a division problem that corresponds with each letter of the alphabet. . The students have to solve all the problems and match their answers (letter of the alphabet) to the coded message. The coded message could be a sentence or a long paragraph depending onthe ability of the group.	As students are working, the teacher can pass among students, helping when necessary.	District adopted text.

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

Rational Numbers: Fractions

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. any integer can be expressed as a fraction.	31	REVIEW					
. a fraction consists of a numerator (which is on top) and a denominator (which is on the bottom) with the line between as a symbol which means divide.	31	9 -	12				
. proper fractions have numerators which are less than the denominator.							
. improper fractions have numerators greater than or equal to the denominator.							
. mixed numbers (forms) consist of a whole number added to a proper fraction.							
The student is able to:							
. identify and write fractions to represent parts of a region.	31						
. identify and write fractions to represent an uncompleted division of two numbers.	33						
. write a fraction for part of a set.	33						
. find fractions that are equivalent to given fractions.							
. order fractions with like denominators.	37						
. locate a fractional number on a number line.	37						
. change mixed forms to improper fractions.							
. change fractions to simplest forms.							
. add and subtract fractions with like denominators.	35						
. add and subtract mixed forms with like denominators.							
. add and subtract fractions with unlike denominators.	35						
. add and subtract mixed forms with unlike denominators.							
. multiply fractions (proper and improper) by fractions and/or by whole numbers.							
. divide fractions.	39						
. divide mixed forms.							
. solve word problems involving fractions using any combination of operations.							
The student values:							

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows any integer can be expressed as a fraction. B. The student knows a fraction consists of a numerator (which is on top) and a denominator (which is on the bottom) with the line between as a symbol which means divide. C. The student is able to identify and write fractions to represent parts of a region.

Related Area(s)

State Goal	1
District Goal	
Program Goal	2,7

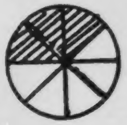
Suggested Activities: Grade(s) 9

Title: Shady Fractions
Group Size: Small group, entire class
Materials: Worksheet

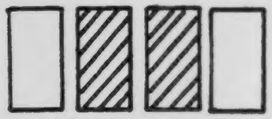
Procedure(s):

- Use a transparency or the chalkboard to illustrate an integer expressed as a fraction with numerator/denominator (5/6, 1/2, 1/4, etc.).
- Give the students a worksheet with sets with parts of the sets shaded or marked.
- Students are to indicate in a fraction form the part of the set that is shaded or marked.

Example(s): 1.



2.



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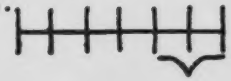
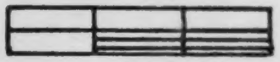


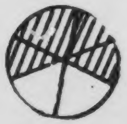
4.



Variation:'

- Indicate an incorrect fraction on the line below the sets and ask the students why it is incorrect.

Example:



3/4 Why? ______________

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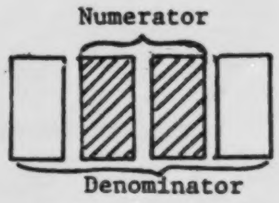
Suggested Monitoring Procedures

Have students label the numerator and denominator in the se sets on the worksheet, i.e.,



Possible Resources

TR, Topic 55, Representing Common Fractions, Wisconsin Research and Development, Center for Cognitive Learning, Rand McNally and Company, 1975

See Small Schools Mathematics Curriculum Grades 7-8

Pages 6, 7, 9, 10, 12, 13, 15, 16, 19, 28, 30, 38, 39

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows a fraction consists of a numerator (which is on top) and a denominator (which is on the bottom) with the line between as a symbol which means divide. B. The student is able to identify and write fractions to represent an uncompleted division of two numbers. C. The student is able to write a fraction for part of a set.

Related Area(s) ______

State Goal	1
District Goal	
Program Goal	2,7

Suggested Activities: Grade(s) 9

Title: Doing the Fraction
Group Size: Small group, entire class
Materials: Worksheet

Procedure(s):
- Study the example below.
- Fill in the missing information.

Example(s): ●0 = 1 out of 2 = 1/2 = 1 - 2 = $2\overline{)1}$

1. ● ● 0 = 2 out of 3 = ___ = 2 - 3 = $3\overline{)2}$
2. ● ● ● 0 = ___ = 3/4 = 3 - 4 = $4\overline{)3}$
3. ● ● ● 0 0 = ___ = ___ = ___ = ___
4. ● ● ● ● ● 0 = 5 out of 6 = ___ = ___ = ___
5. 0 0 0 0 0 0 0 0 = ___ = ___ = ___ = $8\overline{)3}$
6. One of your own:

_____ = _____ = _____ = _____ = _____

Variation:
- Have the students begin with a division problem and reverse the procedure.

Example:
$4\overline{)3}$ = 3 ÷ 4 = 3/4 = three of four ● ● ● 0

Suggested Monitoring Procedures

Peruse worksheets. Group students having difficulty with the concept and re-teach.

Possible Resources

Fundamentals of Mathematics, Stein, Edwin I., Allyn and Bacon, Publishers, 1976.

Holt School Mathematics, Nichols et al, Holt, Rinehart & Winston, 1974

See Small Schools Mathematics Curriculum Grades 7-8
Page 21

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to order fractions with like denominators.

B. The student is able to add and subtract fractions with unlike denominators.

State Goal	1
District Goal	
Program Goal	4,5,7

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Ordering Fractions
Group Size: Entire class
Materials: Worksheet

Procedure(s):

- Students order the fractions from smallest to largest.
- Students then put the corresponding letters in same order on the blanks below to read the message.

NOTE: Individualize by using simple fractions, same numbers, different denominators, for students having difficulty with fractions.

Example:

L = 6/25
C = 1/12
H = 1/10
O = 2/15
S = 1/15
I = 1/4
O - 1/5
S = 3/10
L = 3/4
O = 1/2
O = 2/3
C = 1/3

____ ____ ____ ____ ____ ____   ____ ____

____ ____ ____ ____!

Suggested Monitoring Procedures

Peruse completed message and problems.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 Page 21

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to locate a fractional number on a number line.

B. The student is able to order fractions with like denominators.

State Goal	1
District Goal	
Program Goal	2,7

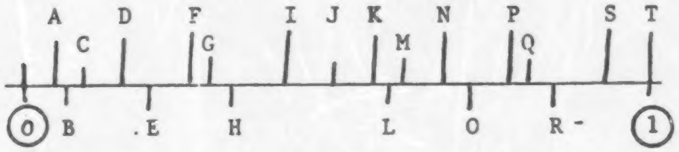
Related Area(s) ____

Suggested Activities: Grade(s) 9

Title: By the Rule
Group Size: Individual, entire class
Materials: Worksheet

Procedure(s):

- Have students match the fractions with each point on the number line by filling in the blanks of the corresponding letter.



___A
___B
___C
___D
___E
___F
___G

___H
___I
___J
___K
___L
___M
___N

___O
___P
___Q
___R
___S
___T

1/2, 1/3, 2/3, 1/4, 3/4, 1/5

2/5, 3/5, 4/5, 1/6, 5/6, 1/8

3/8, 5/8, 7/8, 1/10, 3/10, 7/10,

9,10,

Suggested Monitoring Procedures

Check and reinforce with similar work on a ruler.

Possible Resources

Fundamentals of Mathematics, Stein, Edwin I., Allyn and Bacon, Publishers, 1976.

See Small Schools Mathematics Curriculum Grades 7-8 Page.21

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to divide fractions.

State Goal	1,8
District Goal	
Program Goal	5,6

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Dividing Fractions
Group Size: Entire class
Materials: Paper, pencil, chalkboard

Procedure(s):

- Assign a fraction to each student.
- Call out the names of two students at random.
- Those two people go to the board and divide one fraction by the other (girls fraction by the boys or shorter person by the taller, etc.).
- The first person to get the correct answer gets to choose the next contestants.
- Class also works problems on paper while contestants are at the board.

Example:

1. 3/4 - 1/2 = ____________ (1½)
2. 3/8 - 1/2 = ____________ (3/4)
3. 1/2 - 1/4 = ____________ (2)
4. 5/6 - 2/3 = ____________ (1¼)
5. 4 - 1/2 = ____________ (8)

Suggested Monitoring Procedures

Short quiz on division of fractions. Group students having difficulty with the concept for additional help.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8
Page 21

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

	Page	Suggested Grade Placement	District Placement				
Rational Numbers: Decimals			8	9	10	11	12
The student knows:							
. decimals are another way of expressing a fraction.	43	REVIEW 9 - 12					
. our money system is based on decimals.							
The student is able to:							
. read and write decimals to hundred thousandths.	45-50						
. express a decimal in expanded form to hundred thousandths, e.g., $.438 = \frac{4}{10} + \frac{3}{100} + \frac{8}{1000}$.	47-48						
. express the expanded form of a fraction in decimal form, e.g., $\frac{4}{10} + \frac{3}{100} + \frac{8}{1000} = .438$	43-48						
. order decimals on number line.							
. round decimals up to ten thousandths.	51-52						
. add, subtract, multiply and divide decimals to hundred thousandths.							
The student values:							

SMALL SCHOOL PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows decimals are another way of expressing a fraction. B. The student is able to express the expanded form of a fraction in decimal form, e.g., $\frac{4}{10} + \frac{3}{100} + \frac{8}{1000} = .438$

State Goal	1
District Goal	
Program Goal	1,3

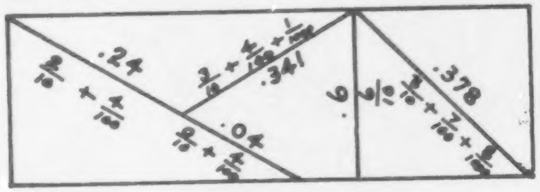
Related Area(s)

Suggested Activities: Grade(s) 9-10

Title: Decimal Puzzle
Group Size: Pairs
Materials: Paper, ruler, scissors

Procedure(s):

- Have each student make a design (see example). Each segment in the design should have a decimal (to the thousandth) on one side and its expanded form on the other side.
Example:



- Cut apart the design to make a puzzle.
- Have students trade puzzles and try to put them back together by matching the decimal and its expanded form.

Suggested Monitoring Procedures

Give students a worksheet with decimals and have them write the expanded notation, i.e.,

$.6 = \frac{6}{10}$; $.25 = \frac{2}{10} + \frac{5}{100}$;

$.75 = \frac{7}{10} + \frac{50}{100}$; $.251 = \frac{2}{10} + \frac{50}{100} + \frac{1}{1000}$

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 Page 33

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

86

87

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to read and write decimals to hundred thousandths.

State Goal	1
District Goal	
Program Goal	1,3

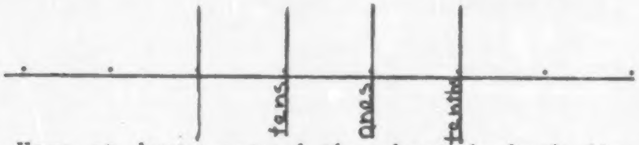
Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Decimal Place Value
Group Size: Small group or entire class
Materials: Chalkboard or worksheet

Procedure(s):

- Begin a place value chart on the chalkboard or duplicate one for each student, i.e.,



- Have students extend the chart in both directions (either orally with you at the chalkboard, or on their worksheets).
- Have students write decimals through thousandths by telling them the place value of each digit. For example, 5 in the tenths place, 6 in the hundredths, and 8 in the thousandths place would be 568.

Suggested Monitoring Procedures

Give students a worksheet of decimal numbers and have them underline the correct numeral as you read them, i.e.,

A. .5432 B. .52 C. 1,68921

Underline 4 hundredths in problem A, 5 tenths in problem B, and 1 hundred thousandths in problem C.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8
Pages 2, 3, 6, 7, 8, 9, 10, 12, 13, 15, 16, 19, 23, 24, 25, 28, 30

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to read and write decimals to hundred thousandths. B. The student is able to express a decimal in expanded form to hundred thousandths, i.e., $.438 = \frac{4}{10} + \frac{3}{100} + \frac{+8}{1000}$. C. The student is able to express the expanded form of a fraction in decimal form, e.g., $\frac{4}{10} + \frac{3}{100} + \frac{8}{1000} = .438$

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,3

Suggested Activities: Grade(s) 9-10

Title: Decimal Expando

Group Size: Small group, entire class

Materials: Cards (3x5) or 3x3)

Procedure(s):

- Have students make a number of cards with basic numerals 1 - 9, a decimal point card, two plus sign cards and an equal sign card. In addition have students make cards with expanded fraction forms of each number, i.e.,

$$\frac{1}{10},\ \frac{1}{100},\ \frac{1}{1000},\ \frac{2}{10},\ \frac{2}{100},\ \frac{2}{1000}$$

etc.

- Read a number and have students form the number with their cards, i.e.,

$$\boxed{.}\quad \boxed{3}\quad \boxed{2}\quad \boxed{5}$$

- Have students match the decimal number with the expanded form in fractions, i.e.,

$$+\ \frac{3}{10} + \frac{2}{100} + \frac{5}{1000}$$

- Variation: Reverse the procedure.

Suggested Monitoring Procedures

Walk among students (class) or observe (small groups) to see if they have arranged cards correctly.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 Page 33

District Resources

Suggested Activities: Grade(s) 9,10

Title: Placing the Decimal
Group Size: Small group, entire class
Materials: Cards (3x5 or 3x3)

Procedure(s):

- Have students make one card for each digit one through nine and one card with a decimal point.
- Read a number containing a decimal and have students arrange their cards to form that number.

Note: Read the decimal as "and."

Example:

4	.	2	8	7

Variation: Arrange cards before the group and call upon students to read the number, or have a student read a number and have other students form the same number with their cards.

Suggested Monitoring Procedures

Walk among students to see if they have arranged the decimal number correctly.

Have students draw place value charts if they have difficulty with this concept, i.e.,

thousands	hundreds	tens	ones	tenths	hundredths	thousandths		
		1	0				10	1 ten
				1			.1	1 tenth
				0	0	1	.001	1 thousandth

Possible Resources

District adopted text.

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to read and write decimals to hundred thousandths. B. The student is able to add, subtract, multiply and divide decimals to hundred thousandths.

Related Area(s)

State Goal	1
District Goal	
Program Goal	5

Suggested Activities: Grade(s) 9,10

Title: Decimal Draw
Group Size: Small groups (two to six students)
Materials: Cards

Procedure(s):

- Make two cards for each of the following numbers: 0, .25, .5, .75, 1, 1.25, 1.5, 1.75, 2, 2.25, 2.5, 2.75, 3, 3.25, 3.5, 3.75, 4, 4.25, 4.5, 4.75, 5.
- Shuffle the cards and put them in a pile.
- The first player draws six cards and tries to make an addition or subtraction equation using three of the cards (if he/she drew the following cards 4, 2.5, 1, .25, .75, 1.5, the player could write 2.5 - 1.5 = 1).
- The player scores one point for a correct equation. If he/she can make more than one equation, additional points can be earned.
- After each player has had a turn, the cards are returned and shuffled and play continues as described above.
- The first player to score ten points wins.

Suggested Monitoring Procedures

Observation of game and correct equations.

Possible Resources

District adopted text.

Small Schools Mathematics Curriculum Grades 7-8 page 33

District Resources

Suggested Activities: Grade(s) 9,10

```
             W 4.F
        __________
N.W4   /H R. H 8 R
       -W 4  8
       -------
          F  F 8
         -4  N 6
         -------
             6 W R
            -6 W R
            ------
                 R
```

- Solution:

  N = 1, W = 2, H = 3, F = 5, R = 0

- For extended activity, have students make up puzzles and exchange.

Suggested Monitoring Procedures

Pass through the class offering help.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 page 33

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to round decimals up to ten thousandths.

State Goal	1
District Goal	
Program Goal	1,3

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Unblank the Blank
Group Size: Individual, entire class
Materials: Worksheet (below)

Procedure(s):

- Round each number below to the nearest hundredth. Find answer in code area. Place letter above problem number.

The purpose of the test is to:

						T								
4	9	12	3	10		1	6	8		13	7	11	2	5

R	I	D	N	O	A	A	R	N	B	E	I	Y	H	T
7.25	4.68	4.49	7.21	4.67	6.80	3.99	3.61	7.85	4.50	3.76	3.96	7.24	4.66	3.16

1) 3.1587 = 3.16
2) 4.6849
3) 3.9552
4) 4.4928
5) 7.8462
6) 4.66098
7) 7.2537
8) 3.75531
9) 3.6052
10) 7.21498
11) 3.9874
12) 6.79536
13) 4.4982

Suggested Monitoring Procedures

Observe classroom activities and check daily work.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 Pages 33,34,35

District Resources

Suggested Activities: Grade(s) 7

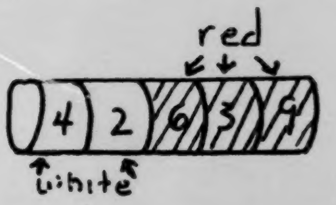
Title: Rounded Decimals
Group Size: Two or more
Materials: Center from roll of paper Towels, strips of paper (red and white)

Procedure(s):

- Write numerals 0 through 9 on each strip so that they appear as an odometer when wrapped around the tube.
- With red representing decimal fraction places, students round off to nearest tenth or hundredth.

Variation: Use thread spools and a pencil. Partition grid paper and put on the cylindrical surface of each spool. The spools can be rotated to expose the digits as on the face of an odometer.

Example:



Suggested Monitoring Procedures

Supply further problems.

Possible Resources

District Resources

SMALL SCH[illegible]S PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows a ratio is a way of comparing two numbers by division, e.g., the ratio of a to b is $\frac{a}{b}$.

State Goal	1
District Goal	
Program Goal	2,7,8

Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Ratio Survey
Group Size: Entire class
Materials:

Procedure(s):

- Survey the class (either orally or on paper) as to such ratios as:
  - left-handed to right-handed.
  - odd-numbered birthdays to even-numbered birthdays.
  - those having at least one brother/sister to those having none.
  - blonds to brunets.
  - those able to swim for five minutes to those unable to swim.
  - those who have flown (or sailed, or ridden on a train, to those who have not).
  - those who have broken bones to those who have not.
  - those born in Washington State to those born outside the state.
  - those who walk to school to those who ride the bus.
  - those who have travelled out-of-state to those who have not.
  - those who ride horses to those who do not.
  - foreign car families to domestic car families.
  - those who have visited Canada to those who have not.

Suggested Monitoring Procedures

Survey responses.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 Pages 9, 10, 12,13,19,25,38,

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTATIONAL SKILLS

	Page	Suggested Grade Placement	District Placement				
Rational Numbers: Ratios, Percentage, Proportion			8	9	10	11	12
The student knows:							
. a ratio is a way of comparing two numbers by division, e.g., the ratio of a to b is $\frac{a}{b}$.		REVIEW 9-12					
. a ratio can be expressed in the following forms: a to b or $\frac{a}{b}$.							
. a percent is defined as a ratio with denominator of one hundred and is denoted by the symbol %, e.g., 50% is $\frac{50}{100}$.							
. a proportion is a statement of equality between two ratios, e.g., $\frac{2}{4} = \frac{6}{12}$.	57						
. in a proportion, the cross-products are equal, e.g., for b and d $\neq 0$, $\frac{a}{b} = \frac{c}{d}$ implies ad = bc.	57						
The student is able to:							
. rename any rational number as a percent, e.g., .05 = 5%; .5 = 50%; $\frac{3}{4}$ = 75%; 2 = 200%; 1½ = 150%.	59						
. rename a number in percent form as either a fraction or decimal, e.g., 100% = 1.00; 75% = .75 = $\frac{3}{4}$ = $\frac{(75)}{100}$; 150% = $\frac{3}{2}$ = $\frac{(150)}{100}$ = 1½ = 1.5; $33\frac{1}{3}$% = $\frac{1}{3}$ = .333...	59						
. solve the three types of percentage problems: a% of b = c: a. given a and b, find c (find 25% of 60). b. given b and c, find a (what percent of 90 is 45?) c. given a and c, find b (25 is 50% of what number?)	69						
. solve for the missing value of a given proportion, e.g., $\frac{8}{X} = \frac{2}{7}$.							
. solve simple word problems involving percent: interest, commission, compound interest, % of change, discount, price.	63						
The student values:							

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows a proportion is a statement of equality between two ratios, e.g., $\frac{2}{4} = \frac{6}{12}$. B. The student knows in a proportion, the cross-products are equal, e.g., for b and d $\neq 0$, $\frac{a}{b} = \frac{c}{d}$ implies ad = bc.

State Goal	1
District Goal	
Program Goal	2,7,8

Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Ratio Rummy

Group Size: Small groups

Materials: Deck of about 60-80 cards containing integers from 0 to 30 (one per card); skip some prime numbers, i.e., 19, 23, 29; have two or three of some composite numbers, i.e., 4, 5, 6, 8, 12, 16.

Procedure(s):

- Shuffle and deal ten cards.
- Place top card on the discard pile.
- First player draws from either pile and must discard.
- The object is to make ratios.
- When a player makes a ratio, i.e., 2/4 = 3/6 (using four cards 2, 4, 3, 6), he/she lays them down.
- All other ratios player makes must be equal to his/her original one (5/10).
- A player may play on an opponent's ratio, also (the cards are placed in front of his/her own place).
- When the deck is exhausted, shuffle the discard pile and turn it over.
- When a player plays all his/her cards, the round is over.
- Scoring is by face value. Thus, 2/4 = 3/6 = 5/10 would equal 30 points (2+4+3+6+5+10).
- Cards left in a player's hand are subtracted from his/her total.
- The first player to reach a total of 100 points is the winner.

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Suggested Monitoring Procedures

Teacher observation of game.
Test.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 page 27

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

111

112

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to rename any rational number as a percent, e.g., .05 = 5%; .5 = 50%; $\frac{3}{4}$ = 75%; 2 = 200%; 1½ = 150%. B. The student is able to rename a number in percent form as either a fraction or decimal, e.g., 100% = 1.00; 75% = .75 = $\frac{3}{4}$ = $\frac{(75)}{100}$; 150% = $\frac{3}{2}$ = $\frac{(150)}{100}$ = 1½ = 1.5; $33\frac{1}{3}\%$ = $\frac{1}{3}$ = .333...

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,3

Suggested Activities: Grade(s) 9,10

Title: Percent Concentration

Group Size: Pairs

Materials: Concentration board, 16 cards with 8 of one color and 8 of another.

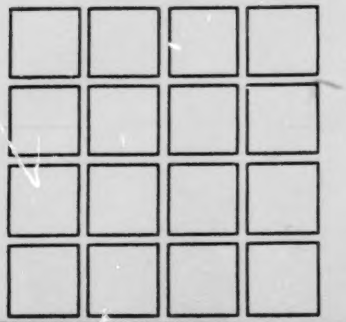
Procedure(s):

- Make up eight cards with rational numbers and eight cards of another color as percentages.
- Place the cards face down on the board. The first player draws a card of each color. If the rational number card and the percentage card match, the player gets one point and draws two more cards.
- If the cards do not match, they are placed face down and the other player gets a turn.
- The winner is the player with the highest total.

Example:

.05	.5	$\frac{3}{4}$	2	$1\frac{1}{2}$	3	.6	.25
5%	50%	75%	200%	150%	300%	60%	25%

CONCENTRATION



Suggested Monitoring Procedures

Observe class; quiz for content retention.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8

page: 27

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
115		116

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to solve the three types of percentage problems: a. given a and b, find c (find 25% of 60). b. given b and c, find a (what percent of 90 is 45?) c. given a and c, find b (25 is 50% of what number?)

State Goal	1
District Goal	
Program Goal	2,6 7,8

Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Three Kinds of Percent
Group Size: Entire class, small group
Materials: Overhead, chalkboard

Procedure(s):

- Write the following on the chalkboard or overhead:
  10% of 60 is 6
  10% of 60 is "a"
  b% of 60 is 6
  10% of c is 6
- Point out that in each case a different number is being found. These are the three basic types of percent problems.
- In three separate lessons, work on the types of percent problems using as many real life problems as possible, i.e., percent of interest, taxes, baseball averages, etc.

Examples of the three types of problems:

5% of 120 = a .05% of 120 = a .05% x 120 = 6	b% of 300 = 60 (think, 60 is what % of 300) $\frac{b\%}{100} = \frac{60}{300}$ 300 b% = 6000 b = 20%	50% of c = 74 .50 c = 74 $\frac{.50}{.50} c = \frac{74}{.50}$ $c = \frac{}{.50}$ c = 148

Suggested Monitoring Procedures

Give students as many real life examples as possible.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 page 27

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to solve simple word problems involving percent: interest, commission, compound interest, % of change, discount, price.

State Goal 1

District Goal

Program Goal 2,6,7

Related Area(s)

Suggested Activities: Grade(s) 7-8

Title: Clearance Sale

Group Size: Entire class

Materials: Large pictures of items students might like, i.e., ski equipment, stereo equipment.

Procedure(s):

- Attach regular sales prices to each item.
- Teacher puts pictures with prices on the bulletin board along with a sign saying "Clearance Sale -- 20% Off!"
- Give students a fixed amount of money to spend.
- Students are to decide which items they could buy with their money.

Given $150, which of these could you buy?

Item	Regular Price	20% Off
ski boots	$ 95.00	______
ski jacket	45.00	______
ski mask	12.00	______
ski gloves	8.00	______
stereo	145.00	______
stereo headphones	35.00	______
speakers	90.00 each	______
turntable	130.00	______

Suggested Monitoring Procedures

Paper and pencil check with similar items.

Possible Resources

District adopted text.
Magazines
Newspapers

See Small Schools Mathematics Curriculum Grades 7-8 page 27

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: MEASUREMENT SKILLS

System International (S.I.) and English Linear

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
• System International prefix meanings: milli--.001; centi--.01; deci--.1; deca--10; hecto--100; kilo--1000.	67	REVIEW 9 - 12					
• millimeter, centimeter, decimeter, decameter, hectometer, kilometer are derived from the S.I. prefixes and base unit meter.							
• commonly used abbreviations.							
• common English linear units of measure are: inch, foot, yard, mile.							
The student is able to:							
• measure lengths using S.I. and English units of measure.	67 69						
• estimate lengths using both systems.							
• convert linear measure to another unit of measure within the same system (inches to feet; meters to centimeters).							
The student values:							

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows System International prefix meanings: milli--.001; centi--.01; deci--.1; deca--10; hecto--100; kilo--1000.

B. The student is able to measure lengths using S.I. and English units of measure.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,2,6

Suggested Activities: Grade(s) 9,10

Title: How Big?
Group Size: Small groups
Materials: Sets of twine cut to specific metric lengths, task cards

Procedure(s):

- Teacher makes sets of twine metric linear measures and labels them.
- The teacher assembles sets in packets.
- Specify that objects are to be measured in more than one unit, and that items can be measured by combinations of measures, i.e., meters and cm.

Example:

TASK CARD

Measure how high, then how wide the following items are: door, window and the teacher's desk. Express the measure in metres and centimeters.
If the measure were rounded off to the most precise unit what unit would it be?

- Suggested follow up: Have students do the same activity using English units of measure or reverse procedure during English units first.

Suggested Monitoring Procedures

Teacher checks completed task cards.

Possible Resources

District adopted text.

See Small Schools Mathematics Curriculum Grades 7-8 pages 12, 19, 28, 30, 38, 45, 47

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

District Resources

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to measure lengths using SI and English units of measure.

State Goal	1
District Goal	
Program Goal	1,2,6

Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Metric Rummy (see Ratio Rummy for equivalence for rules).

Group Size: Small groups

Materials: Deck of 60-80 cards containing equivalent metric units (one unit per card).

Example: $\boxed{\text{2dm}}$ $\boxed{\text{20cm}}$

3-4 cards equivalent for each group.

Procedure(s):

- Shuffle and deal 10 cards.
- Place top card on discard pile.
- Play starts at dealer's left.
- 1st player draws from their pile, discard or
- The object is to find equivalent cards.
- 1st person to play all his cards receives 25 bonus points. Cards should be numbered 1-20 with various equivalents only. Numbers between 1-20 can count.
- Score is total points at end of class period a time limit.

Suggested Monitoring Procedures

Monitor class offering help.

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 pages 30, 42

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: MEASUREMENT SKILLS

S.I. and English Capacity

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. that liter is the basic unit of S.I. measurement.			REVIEW				
. that milliliter, centiliter, decileter, decaliter, hectoliter and kiloliter are S.I. units of measure derived from the S.I. prefixes and the base unit liter.			9 - 12				
. commonly used abbreviations.							
. basic English units of capacity measurement are cup, pint, quart and gallon.	73						
The student is able to:							
. measure capacity using S.I. and English units of measure.	73						
. estimate capacity using S.I. and English system.	73						
. convert capacity measure from one unit to another within the same system (cups to quarts, milliliters to liters, etc.)	73						
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows basic English units of capacity measurement are cup, pint, quart and gallon. B. The student is able to measure capacity using S.I. and English units of measure. C. The student is able to estimate capacity using S.I. and English system.
D. The student is able to convert capacity measure from one unit to another within the same system (cups to quarts, milliliters to liters, etc.)

State Goal	1,6
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9,10

Title: Metric Measures
Group Size: Small group, entire class
Materials: Sets of containers

Procedure(s):

- Point out to students that in metric capacity the basic units are the liter (1) and the milliliter (ml). Metric cups are also used as an aid in measuring.
- Show students a chart for comparison as follows:
  1000 milliliters = 1 liter
  250 milliliters = 1 metric cup
  4 metric cups = 1 liter
- Have students measure liquid and dry items refering to the chart when necessary, i.e., water, sand, flour, cornmeal, juice.
- Give students a worksheet and have them express answers in the most recise metric terms.

Example(s):

1. A recipe calls for 1/5 metric cup: how many milliliters are needed? (50 ml)
2. How many metric cups are 1-1/2 liters? (6 ml)
3. Measure two metric cups of juice. How many milliliters is that? (125 ml) How many liters? (1-1/2 1)

Suggested Monitoring Procedures

Have students choose the most sensible measure:

1. milk carton
   2 ml   2 1
2. juice pitcher
   25 ml   1 1
3. sack of cornmeal
   380 ml   5 1
4. one metric cup of water
   250 ml   1 1
5. cottage cheese box
   125 ml   3 1

Possible Resources

See Small Schools Mathematics Curriculum Grades 7-8 pages 12, 19, 28, 30, 38, 47

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
137		138

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: MEASUREMENT SKILLS

S.I. and English: Weight (Mass)

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. gram is the base unit of S.I. measurement.		REVIEW					
. milligram, centigram, decigram, decagram, hectogram, kilogram are derived from the S.I. prefixes and base unit gram.	77	9 - 12					
. commonly used abbreviations for weight.	77						
. basic English weight units of measure are ounce, pound, ton.							
The student is able to:							
. convert from one unit to another in the same system.							
. measure the weight of an object using a balance scale in both English and S.I.							
. estimate weight using English and S.I.							
The student values:							

139

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows milligram, centigram, decigram, decagram, hectogram, kilogram are derived from the S.I. prefixes and base unit gram. B. The student knows commonly used abbreviations for weight.

Related Area(s)

State Goal	1
District Goal	
Program Goal	2,4

Suggested Activities: Grade(s) 9,10

Title: Heads or Tails?
Group Size: Small group
Materials:

Procedure(s):

- On a sheet of paper write the names of all players across the top of the page. Down the left margin write the names kilogram, hectogram, decagram, gram, decigram, centigram and milligram.
- A numeral such as 435.678 is written before the game starts and represents a measure of 435.678 grams. (Use a six-digit numeral.)
- Five coins are flipped simultaneously and the first player can then choose to move the decimal point to the right as many places as he/she has "tails" showing.
- In no case may player form a numeral that requires the addition of zeros to place the decimal point the proper number of places.
- If a movement to the right or left cannot be accommodated with the results of his/her coin toss, player must pass.
- After the decimal point has been moved the player must correctly identify the new measure name in terms of the previous name.
- For example: If the original number represented a measure of 435.678 grams and the player chose to move the decimal three places to the right, the new number would represent a measure of 435678. milligrams.

(Continued on back of page.)

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Suggested Monitoring Procedures

Observation
Monitor activity

Possible Resources

Let's Play Games in Metric, Henderson, National Textbook Co.

See Small Schools Mathematics Curriculum Grades 7-8 pages 12, 19, 28, 30, 38, 45

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

- If player correctly identifies the new measure he/she places a check (✓) under his/her name across from the proper measure (milligram).
- The play then moves to the next person, who begins with the measure 435678. milligrams and flips the coins to determine the placement of the decimal point.
- Play continues in this manner until someone has completed checking all the measure names listed on the scoresheet.
- The first player to do this is the winner.
- Players will develop various strategies to move the decimal point to complete their columns and to block the completion of their opponents' columns.

Variation: Have students move decimal point when they change units.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: MEASUREMENT SKILLS

Temperature: Celsius and Fahrenheit

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. degree Celsius is used to measure temperature in the S.I.	81	REVIEW 9 - 12					
. the symbol for Celsius is C.							
. common temperature references: 0°C. is freezing point of water; 20°C is room temperature; 37°C is normal body temperature; 100°C is boiling point of water.							
. the symbol for Fahrenheit is F.							
. common temperature references in Fahrenheit: 32°F= freezing point of water; 68°F is room temperature; 98.6°F is normal body temperature; 212°F is boiling point of water.							
The student is able to:							
. read a thermometer in both Celsius and Fahrenheit.	81						
. calculate differences in degrees.							
. estimate approximate temperature conversions from Celsius to Fahrenheit.							
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows degree Celsius is used to measure temperature in the S.I. B. The student knows the symbol for Celsius is C. C. The student is able to read a thermometer in both Celsius and Fahrenheit.

State Goal	1
District Goal	
Program Goal	2,4

Related Area(s)

Suggested Activities: Grade(s) 9,10

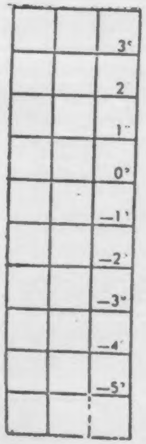
Title: Celsius Temperature
Group Size: Entire class
Materials: Centimeter graph paper

Procedure(s):

- Have students construct a Celsius thermometer by doing the following:
- Students draw on centimeter graph paper a number line 110 cm long. Have them make the thermometer 3 cm wide. (Add strips of graph paper if necessary to make strip long enough.)
- Students number each line starting at $-5^{\circ}C$ at the bottom, and numbering by ones to the top of the thermometer. (Position thermometer vertically when writing numbers.)
- Have students mark on thermometer the following degrees:

body temperature	$37^{\circ}C$
boiling H_2O temperature	$100^{\circ}C$
freezing temperature	$0^{\circ}C$
simmer day	$28^{\circ}C$
winter day	$-1^{\circ}C$
fish bowl temperature	___
oven temperature for baking brownies	___

Example:



Suggested Monitoring Procedures

Teacher observation.

Possible Resources

Metric Tasks, Skill Developmental Activities, Marilyn Sue Corey, Love Publishing Co., Denver, CO Task 36.

See Small Schools Mathematics Curriculum Grades 7-8 pages 12, 19, 28, 30, 38, 45

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: MEASUREMENT SKILLS

Money / Time

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the basic units of money covered in K-8: penny, nickel, dime, quarter, half-dollar, dollar.	85	REVIEW 9 - 12					
. common denomination of bills: one, two, five, ten, twenty, fifty, hundred, five hundred.							
. the basic units of time: seconds, minutes, hours, days, week, month, year, decade, century.							
The student is able to:							
. read and write any money amount.							
. count change beginning with a specified amount.							
. solve word problems involving money, using the four basic operations.	85-86						
. estimate money.	85-86						
. convert a unit of time to another unit (hours, minutes, seconds, days, weeks, months, years).							
. compute time intervals between two given times.	87						
. read time charts (schedules, time zones, time clock).	87						
. solve word problems.	85-86						
The student values:							

SMALL SCHOOLS PROJECT

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows basic units of money covered in K-8: penny, nickel, dime, quarter, half-dollar, dollar. B. The student is able to solve word problems involving money, using the four basic operations. C. The student is able to estimate money. D. The student is able to solve word problems.

Related Area(s)

State Goal	1
District Goal	
Program Goal	3,6,8

Suggested Activities: Grade(s) 9	Suggested Monitoring Procedures	Possible Resources
Title: Shopping Spree **Group Size:** individual, entire class **Materials:** newspaper, pencil and paper, calculator (optional) **Procedure(s):** • Teacher sets a maximum amount to be spent on shopping spree ($10 or $20, or other reasonable maximum). • Using the supermarket advertisements, students "shop" at one market only, selecting food items from each of the basic food groups (dairy, meat, cereal grains, fruit and vegetables). • Students record item(s) selected and price. • Students total purchases, and must return some items if they exceed pre-set amount to be spent. • Student or teacher checks total on calculator.	Teacher observation and individual assistance.	See Small Schools Mathematics Curriculum Grades 7-8 page 33 District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Suggested Resources

Title: Mail Order Math
Group Size: entire class
Materials: catalogues or supplements, facsimiles of order form (see example), calculator (optional)

Procedure(s):

- Have each student select a topic (shop, kitchen, bedroom, clothing, etc.) or draw lots from prepared slips of paper with one topic on each.
- Each student completes order sheet; ordering three or more items (clothing: 1 shirt, 1 pair pants, 1 pair shoes).
- Student totals amount of order.
- Student (or teacher) checks total on calculator.

District Resources

SMALL SC[illegible]S PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student is able to compute time intervals between two given times. B. The student is able to read time charts (schedules, time zones, time clock).

State Goal	1
District Goal	
Program Goal	1,2,3,4.

Related Area(s)

Suggested Activities: Grade(s) 9,10	Suggested Monitoring Procedures	Possible Resources
Title: Time to Travel **Group Size:** Small groups **Materials:** Per group: Greyhound time table, paper to keep track of travel, map of Pacific Northwest	Teacher observation Quiz	See Small Schools Mathematics Curriculum Grades 7-8 page 43

Procedure(s):

- Each group is given three days (72 hours) to travel around the Pacific Northwest.
- They are to keep track of the time they are traveling and the time between travel. At the end of the third day, they must return to their starting point.
- The group which has spent the most time on the bus and the least amount of time waiting is the winner.

Variation: Each group is given three weeks to travel via airlines with special package flights e.g., can stop at two other cities on flight if done within specific time period.

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

156

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATIONS

Graphs

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. a graph is an organized collection of information.	91-94	11-12					
. there are various types of graphs: pictographs, bar, line, broken line, circle. (see objectives p. 109 Small Schools K-8)	91-94						
The student is able to:							
. tabulate collected data in rank order.							
. plot tabulated data.	95-96						
. read and interpret data on pictographs, bar graphs, line graphs, and circle graphs.	95-96						
. construct pictographs, bar graphs, line graphs, and circle graphs from given or collected data.	91-94						
The student values:							
. graphs, as a source of information.							

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Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows a graph is an organized collection of information. B. The student is able to tabulate collected data in rank order. C. The student is able to construct pictographs, bar graphs, line graphs, and circle graphs from given or collected data.

State Goal 1
District Goal
Program Goal 2,4,6

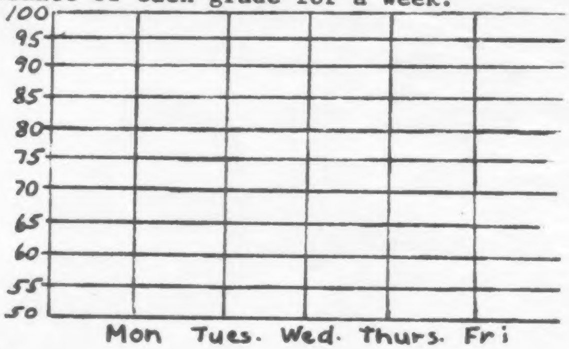
Related Area(s)

Suggested Activities: Grade(s) 9

Title: Graph It
Group Size: entire class
Materials: straight edge and graph paper

Procedure(s):

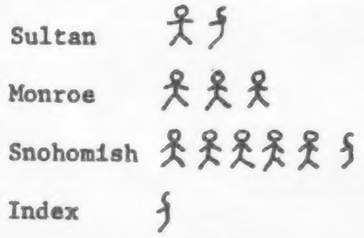
- Construct a multiple line graph showing the attendance of each grade for a week.



Title:
Group Size: entire class
Materials: statistics on population of neighboring towns

Procedure(s):

- Construct a pictograph illustrating the sizes of several Snohomish County towns.



Suggested Monitoring Procedures

Have students construct additional multiple line graphs with different data.

Have students construct additional pictographs from different data.

Possible Resources

Mathematics For Today
Oxford Book Company,
Los Angeles, CA

Activities in Mathematics
Graphs - Second course
Scott Foresman & Co.,
Glenview, Illinois 60025

District Resources

Atlas, encyclopedias

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Suggested Activities: Grade(s) _______

Each 🯅 **= 1000 people**

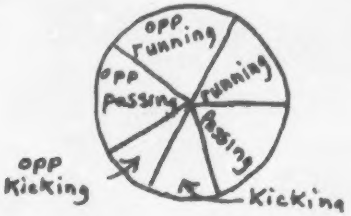
Population in 1000's

- **Have students construct a pictograph of the population of corresponding high schools using 250 for each symbol.**

Title:
Group Size: entire class
Materials: statistics from a football game out of a newspaper

Procedure(s):

- **Have students collect data from a football game or give them the statistics of a recent game.**
- **Figure the percentage of plays of home team (running, passing, kicking) and visitors (running, passing, kicking).**
- **Construct a circle graph showing the percentage of each.**



Variation:

- Have students put data in rank order. Then construct a bar graph showing the rank order.

Suggested Monitoring Procedures

Have students construct additional circle graphs from different data.

Possible Resources

Newspaper, magazines, etc.

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows a graph is an organized collection of information. B. The student is able to plot tabulated data. C. The student is able to construct pictographs, bar graphs, line graphs, and circle graphs from given or collected data.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

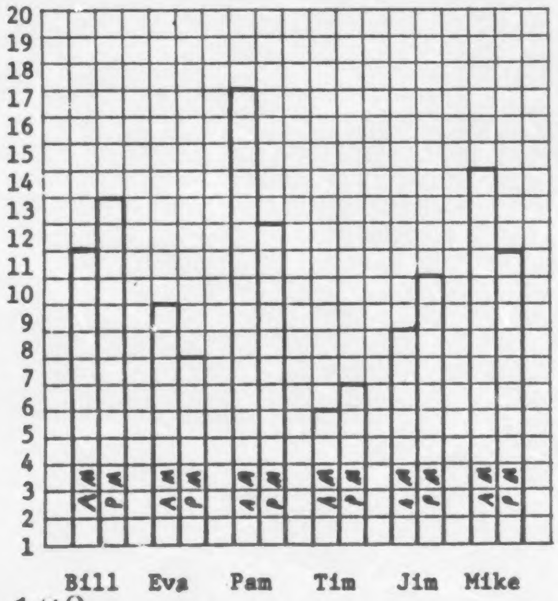
Suggested Activities: Grade(s) 11-12

Title: Double Tic-Tac-Graph
Group Size: pairs
Materials: paper, pencil, graph paper

Procedure(s):

- Students play twenty games of tic-tac-toe in the morning, twenty in the afternoon, keeping track of the winners or cat games.
- Then they construct a double bar graph to show the results.

Example:



Suggested Monitoring Procedures

Teacher observation.

Possible Resources

District adopted text

District Resources

Suggested Activities: Grade(s) 11-12

Variations: Have students from two classes polled as to their favorite sports, foods, colors and make appropriate graphs.

NOTE: Hangman or other short games could be used also.

Title: Five in a Row

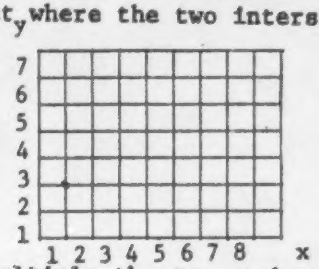
Group Size: entire class

Materials: overhead projector, transparency of an x-y coordinate grid, or worksheet with grid

Procedure(s):

- Explain terms before playing game.
- Divide students into two teams. To one team at a time, call two numbers from zero to ten, i.e., 2,3.
- Team members plot the two numbers on the grid, i.e., go two over on the x or horizontal axis and up three on the y or vertical axis, and mark the point where the two intersect.

Example:



- Students then multiply the two numbers, i.e., 2x3=6. If answer is correct, team gets to keep their mark on the grid. If answer is incorrect, mark is removed.
- The first team to set five marks in a row on the grid (horizontally, vertically or diagonally) wins the game.

Suggested Monitoring Procedures

Teacher observes responses and makes necessary corrections.

Possible Resources

District Resources

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Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows there are various types of graphs: pictographs, bar, line, broken line, circle. B. The student is able to plot tabulated data. C. The student is able to read and interpret data on pictographs, bar graphs, line graphs, and circle graphs.

State Goal	1
District Goal	
Program Goal	3,4,6

Related Area(s)

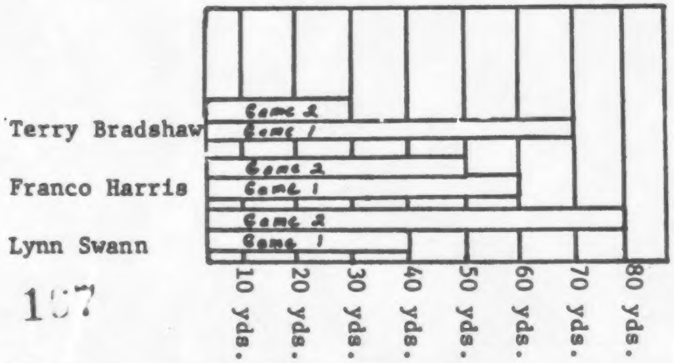
Suggested Activities: Grade(s) 11-12

Title: Bar None
Group Size: entire class
Materials: graph paper grid already dotted, strips of colored construction paper (each with its own value: red=1 unit, blue=2 units, green=5, black=10, orange=20)

Procedure(s):

- Give each student a grid worksheet and a collection of the unit strips.
- Pick some familiar topic such as number of yards different football players carry the ball per game.
- Put data on board.
- Help students put amounts (units) on a horizontal axis and subjects on vertical axis.
- Then have students pick colored strips that would equal same number as data on board.
- Arrange largest colored strip on bottom, then in order, etc.

Example:



Suggested Monitoring Procedures

Teacher leads responses and helps if necessary.

Possible Resources

Activities in Mathematics: Graphs - Second Course
Scott Foresman & Company,
Glenview, Illinois 60025

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

Title: Graph Greats

Group Size: entire class

Materials: graph worksheet without units and names but with bars and units marked

Procedure(s):

- Give pairs of students prepared graph worksheet. Have the bars and units marked but unnamed.
- Let students name and mark the bars and units so anyone can interpret the graph.
- When finished, students trade graph papers with other pairs of students.
- Then ask students questions that would apply to all graphs such as:
  - What is the name of the graph?
  - What are units?
  - How does bar number 2 compare to bar number 5?
- Responses can be oral or students may write them on paper and then discuss.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATIONS

Personal Finances

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. various sources of income, e.g., employment, investments.	99	11-12					
. that a budget is a systematic approach to planning future spending, saving, and investment income.							
. checking account services vary from one financial institution to another.	101						
. world currency exchange rates vary from time to time.							
The student is able to:							
. solve practical problems using basic operations.	103						
. keep records of personal income, savings and expenditures.							
. prepare a personal budget.	105						
. plan spending for food, clothing and services to obtain the greatest value.	105						
. solve problems related to sales tax.	107						
. solve problems related to income tax.	99						
. read personal payroll statement and reconcile it with gross earnings.	103						
. manage a personal bank checking account (complete form, make deposits, keep and balance records).	101						
The student values:							

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Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows various sources of income, e.g. employment, investments. B. The student is able to solve problems related to income tax.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 11-12	Suggested Monitoring Procedures	Possible Resources
Title: **Group Size:** entire class **Materials:** tax booklets from previous years **Procedure(s):** . Make a list on the board of all types of income, earned and unearned (brainstorm). . Make a list of possible income tax deductions. . Discuss which incomes and deductions are relevant to given occupations. (Farmers can depreciate equipment, waitresses must claim tips, teachers can deduct education, etc.)	Teacher observation.	Understanding Taxes local Internal Revenue office Mathematics For The Real World Charles E. Merrill Publishing Company, Columbus, Ohio 1978 Consumer and Career Mathematics Scott, Foresman and Company Glenview, Illinois 60025

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
174		District Resources
		175

SMALL SCHOOLS PROJECT

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that checking account services vary from one financial institution to another. B. The student is able to manage a personal bank checking account (complete form, make deposits, keep and balance records).

State Goal	1
District Goal	
Program Goal	.4.6

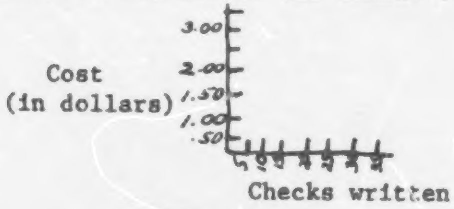
Related Area(s)

Suggested Activities: Grade(s) 11-12

Title:
Group size: entire class, individuals
Materials: examples of cost of different types of checking accounts from local banks

Procedure(s):

- Hand out a sheet summarizing the cost of various checking accounts, (examples of costs).
- Construct a broken line graph comparing the cost of each account to the number of checks written:



- Have students answer prepared questions about accounts (what are drawbacks to the "minimum $200 balance," etc.

Suggested Monitoring Procedures

Teacher observation and questions.

Possible Resources

Bank literature, forms and prospectus

Bank personnel

District Resources

Suggested Activities: Grade(s) 11

Title:
Group Size: two or three students
Materials: deposit and withdrawal forms from banks

Procedure(s):

- Establish checking and savings account balances.
- Over a period of two weeks, 2 or 3 bank transactions each day, complete by filling out appropriate forms.
- Check the balance every other day.
- Complete the activity by reconciling a bank statement.

Suggested Monitoring Procedures

Teacher observation.

Group students who are having problems for special help.

Possible Resources

Check Writing Lab
Seattle First National Bank

This is Your Life
Elaine Linsay, Project
Pacoima Mathematics Demonstration Center, 9919 Laurel Canyon Blvd., Pacoima, CA 91331

Mathematics for the Real World
Charles Merrill Pub. Co.
a Bell & Howell Company
Columbus, OH 43216

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student is able to solve practical problems using basic operations. B. The student is able to read personal payroll statement and reconcile it with gross earnings.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s) See section on graphs

Suggested Activities: Grade(s) 11-12	Suggested Monitoring Procedures	Possible Resources
Title: **Group Size:** two or three students **Materials:** several payroll statements **Procedure(s):** . Divide students into groups of two or three. . Present each group with a payroll statement (different jobs). . Figure the percent of gross earnings for each deduction. . Construct a circle graph to illustrate each deduction. . Compare graphs as a group.	Teacher observation.	Mathematics For The Real World Charles Merrill Publishing Co. A Bell & Howell Company Columbus, Ohio 43216
		District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
Title: Payroll **Group size:** entire class **Materials:** payroll statements on a worksheet **Procedure(s):** - Give students worksheets with different sample paychecks and statement of earnings and deductions. - Have students determine the gross pay and compare it with net pay. - Have students determine deductions in two categories (a) fringe benefits and (b) state and federal deductions. - Have students determine the amount of fringe benefits as though they were salary. - Have students determine the amount of employer contributions and employee contributions to FICA and fringe benefits.	Have student compare their worksheets and discuss payrolls, deductions and fringe benefits.	The Consumer in America Plunkett, Richard Center for the Study of Instruction Harcourt, Brace and Jovanovich New York, 1979
		District Resources

SMALL SCHO[illegible]S PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student is able to prepare a personal budget. B. The student is able to plan spending for food, clothing and services to obtain the greatest value.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

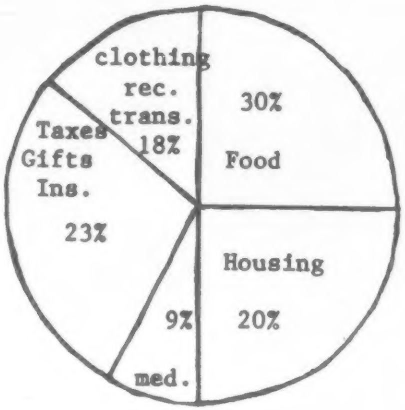
Suggested Activities: Grade(s) 11-12

Title:
Group Size: individuals
Materials: estimated budgets

Procedure(s):

- Have students choose a job possibility.
- The instructor estimates an income for each.
- Student prepares a personal budget given the income including cost of food, clothing and services.
- Construct a circle graph to illustrate the budget items.
- Compare graphs as a group.

e.g.,



Suggested Monitoring Procedures

Teacher observation.

Possible Resources

Mathematics in Life: Skills, Consumer and Career Applications. Scott Foresman & Company
Palo Alto, California 1977

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources
186		187

SMALL SCHOO PROJECT

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to solve problems related to sales tax.

Related Area(s)

State Goal	1
District Goal	
Program Goal	2,4,6

Suggested Activities: Grade(s) 11-12

Suggested Activities	Suggested Monitoring Procedures	Possible Resources
Title: Challenge **Group size:** entire class **Materials:** newspaper ads, tax tables **Procedure(s):** • Divide the class into two teams. • Each team has one person competing at a time. • Choose an item and its price and have each student estimate its sales tax, in five seconds. • The closest estimate wins, while the loser sits down. • The team with the last person(s) up wins.	Give students a worksheet with items to figure sales tax.	
Title: **Group size:** two or three students **Materials:** cards with city and percent sales tax and cards with a list of items and their cost **Procedure(s):** • Divide class into groups. • Have each group pick one card with a city and one card with items. Keep them face down until the teacher says to begin. • Each group is to sort the taxable and nontaxable items and calculate the tax for their given city. They are to total the cost of all items and the tax. • The first group to get the correct total wins.	Teacher observation.	State of Washington list of food items not taxed. City regulations, ordinances. District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATIONS

Personal Finances: Credit and Interest

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. common types of housing available and the advantages/disadvantages of each (single family residence, apartment, condominium, etc.).		11-12					
. ways in which federal and state laws regulate credit (e.g., credit card regulations, truth in lending laws).							
. sources of credit and methods of establishing credit.	111						
. advantages and disadvantages of credit buying.	111-115						
. interest on savings accounts vary depending on type of account and type of financial institution (certificate account, treasury notes, commercial banks, savings and loan associations, credit unions).	117						
. fees for bank services vary from commercial banks and savings and loans.							
. formula for computing interest and its components: $i = prt$.							
The student is able to:							
. determine the cost of credit given the cost of the item purchased, the monthly payments and the number of payments.	111-115						
. compute interest (simple or ordinary) for periods of one, two, three years, etc.).	115						
. recognize and compute simple and compound interest.	117-119						
. identify the components of a mortgage payment, e.g., interest, principal, property tax, insurance.	119						
The student values:							

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows sources of credit and methods of establishing credit. B. The student knows advantages and disadvantages of credit buying. C. The student is able to determine the cost of credit given the cost of the item purchased, the monthly payments and the number of payments.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,6

Suggested Activities: Grade(s) 11-12

Title:
Group Size: two students
Materials: various credit plans and requirements from local sources of credit

Procedure(s):
- Students are given different prepared budgets.
- Have students determine their debt and income ratio.
- From this they are to determine, from a table* what source of credit they could use to purchase a new $600. television set.
- They must then determine the cost of credit of that item.

***Table**

Source	Maximum debt/ income ratio	Payment Plan
Comm. bank	33%	$30/mo. for 30/months
Savings bank	25%	$40/mo. for 24/months
Credit union	etc.	etc.
Finance Co.	"	"
Loan shark	"	"

Suggested Monitoring Procedures

Teacher observation.

Possible Resources

Consumer and Career Mathematics
Scott Foresman and Company
Glenview, Illinois 1978

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
195		196

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows the advantages and disadvantages of credit buying.
B. The student is able to determine the cost of credit given the cost of the item purchased, the monthly payments and the number of payments.

State Goal	1
District Goal	
Program Goal	1,6

Related Area(s)

Suggested Activities: Grade(s) 12

Title:
Group Size: two or three students
Materials: several different prepared budgets

Procedure(s):

- Each group is given a prepared budget and a crisis which affects that budget.
- Given a maximum debt to income ratio, each group must decide what to do to reduce the ratio (the ratio becomes hither with the crisis; lower income, added expense, etc.). In each case it should be obvious that some payment(s) (car, stereo, etc.) must be eliminated. They are to choose the best method.
- As a group, discuss their choice of dealing with the problem as compared to repossesion and deficeincy judgement or wage garnishment.

Suggested Monitoring Procedures

Teacher observation.

Lead a discussion on the responses the teacher feels were most interesting.

Possible Resources

Consumer and Career Mathematics
Scott Foresman & Company
Glenview, Illinois 1978

District Resources

Suggested Activities: Grade(s) ______

Title:
Group Size: entire class
Materials:

Procedure(s):

- Have the class brainstorm advantages and disadvantages of credit buying. Group the responses under two lists - advantages and disadvantages.
- Ask personnel from a lending institution to discuss some of the ideas in depth with the class, e.g.:
  1. to establish credit
  2. to be able to enjoy certain things without waiting until you have saved up enough money
  3. some things such as housing/auto would be almost impossible to acquire without credit buying
  4. good for economy
  5. tax savings
  6. must pay interest
  7. can cause overspending

Suggested Monitoring Procedures

Lead discussion; have students research the topic, discuss again.

Possible Resources

Tax analyzer

Credit bureau

Money management counselor

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows the advantages and disadvantages of credit buying. B. The student is able to determine the cost of credit given the cost of an item purchased, the monthly payments and the number of payments. C. The student is able to compute interest (simple or ordinary) for periods of one, two or three years.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1, 6

Suggested Activities: Grade(s) 12

Title:
Group Size: entire class
Materials: ditto

Procedure(s):

- Compare approximate total amount to be paid back on a $3,000 loan at 12% for one year vs. 36% for one year.

Two families want to purchase a refrigerator and stove from a department store.

A. Family A has a debt to earning ratio too high to allow credit to be established at store - have to go to Finance Company and borrow $3,000 at 36%. Compute approximate amount to be paid back in one year period.

B. Family B has an established credit rating and has an appropriate debt to earning ratio and is able to purchase item from store.

A. $3,000 x 36% = $1,080 = $4,080
B. $3,000 x 12% = $ 360 = $3,360

Suggested Monitoring Procedures

Discuss outcomes and differences.

Possible Resources

Lending institutions materials

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
203		District Resources 204

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows interest on savings accounts varies depending on type of account and type of financial institution. B. The student is able to recognize and compute simple and compound interest.

State Goal 1

District Goal

Program Goal 1,6

Related Area(s)

Suggested Activities: Grade(s) 12

Title:

Group size: entire class, individuals

Materials:

Procedure(s):

- Give the student a hypothetical situation where they have an amount of money ($500, $1,000, etc.) to deposit in a savings account. Have them analyze the steps they must take to determine the best place to deposit this money.
  1. Commercial Bank vs. Savings & Loan vs. Credit Union. (what interest rate does each institution pay?)

Example:

Commercial Bank	5%
Savings & Loan	5½%
Credit Union	6%

- Have the student compute the difference on amount of money at end of year for each bank.

Suggested Monitoring Procedures

Observe and monitor.

Possible Resources

Personnel from various institution

Booklets, materials from lending institutions.

District Resources

2̄05

206

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
207		
		District Resources
		208

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student is able to identify the components of a mortgage payment, e.g., interest, principal, property tax, insurance. B. The student is able to compute simple and compound interest.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1.6

Suggested Activities: Grade(s) 12

Title:

Group Size: two or three students

Materials: payment summary of a typical home mortgage

Procedure(s):

- All students are given the components of each payment of a 30-year mortgage.
- Each group constructs a circle graph, of different payments, which represents the percentage of the payment going to each component.
- As a class compare graphs to demonstrate differences in interest and principal.

Variation:

- Obtain interest payment booklets or charts and have students determine the differences in a 20-year mortgage as compared to 25 and 30 years.

Suggested Monitoring Procedures

Teacher observation.

Possible Resources

Mathematics For Everyday Life
Charles Merrill Company
A Bell & Howell Company
Columbus, Ohio 43216

Consumer and Career Mathematics
Scott Foresman & Company
Glenview, Illinois 1978

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
211		212

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATION

Personal Finances: Insurance

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that insurance is a method of providing protection against losses incurred as a result of death, accident, damage, loss of salary, etc.	123	11-12					
. that there are various types of health and life insurance available with distinct advantages based on age of insured, health, size of family, income.	125						
. that there are various types of automobile insurance available with distinct advantages based on age, health, and driving record.	127						
. that automobile insurance can include different kinds of coverage, e.g., collision, personal liability, property damage, fire and theft.							
. homeowners insurance covers buildings, personal property, household belongings.	131						
The student is able to:							
. compare and select appropriate types of personal insurance based on needs, e.g., term vs. whole life, group vs. individual health insurance.	125-129						
. compare and select appropriate types of auto insurance.							
. compare and select appropriate type of homeowner's insurance.	131						
The student values:							
. insurance as a form of protection from financial disaster.							

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that insurance is a method of providing protection against losses incurred as a result of death, accident, damage, loss of salary. B. The student is able to compare and select types of personal insurance based on needs, e.g., term or whole life, group or individual health insurance.

State Goal	1
District Goal	
Program Goal	1, 6

Related Area(s)

Suggested Activities: Grade(s) 12

Title:
Group Size: entire class
Materials:

Procedure(s):

- Brainstorm all types of risks involved in life.
- Construct a matrix and list possible responses to these risks (some insurances will cover more than one risk).
- Have student research ideas one evening and finish the matrix the second day.

RISK	RESPONSE HEALTH INS.	LIFE INS.	S.S.	CAR INS.	FIRE INS.
Death		X	X		
Disability	X		X		
Sickness	X				
Loss of income	X				
Damage to car				X	
Damage to house					X
Retirement		X	X		

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Suggested Monitoring Procedures

Have students prepare a personal risk/response matrix.

Possible Resources

Consumer and Career Mathematics
Scott Foresman & Company
Glenview, Illinois 1978
Mathematics In Life
Scott Foresman & Company
Glenview, Illinois 1977
Consumer Mathematics
Harcourt, Brace, Jovanovich
New York, N.Y. 1979
The Consumer in America
Center for the Study of Instruction
Harcourt, Brace & Jovanovich
San Francisco, California 1979

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

District Resources

216

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows there are various health and life insurance available with distinct advantages based on age of insured, health, size of family, income. B. The student is able to compare and select appropriate types of personal insurance based on needs, e.g., term vs. whole life, group vs. individual health insurance.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,6

Suggested Activities: Grade(s) 12

Title:
Group Size: four or five students
Materials: advertising brochures from local health insurance companies

Procedure(s):

. Divide class into groups of four or five students.
. Have each group compare each company's plan pertaining to:
(a) deductible
(b) coverage of drugs
(c) office calls
(d) hospital
(e) maternity
(f) major medical
(g) availability of physicians
(h) premium rates
. Summarize advantages and disadvantages of each plan.

213

Suggested Monitoring Procedures

Teacher will act as discussion leader.

Possible Resources

Independent insurance agent

The Consumer in America
W. Richard Plunkett
Center for the Study of Instructio
San Francisco, California
Harcourt, Brace, Jovanovich 1979

District Resources

219

Suggested Activities: Grade(s) ______

Title:
Group Size: four or five students
Materials: brochures of coverage and cost of different plans from local life insurance companies

Procedure(s):

- Divide the class into groups of four or five students. Have each group compare:
  - A) Whole life vs. term insurance
  - B) Aspects of different plans
    - 1) cost (age, family size, etc.)
    - 2) death benefits
    - 3) retirement benefits
    - 4) disability benefits
- Summarize advantages and disadvantages of whole life vs. term insurance.
- Summarize advantages and disadvantages of different plans.

Suggested Monitoring Procedures

Teacher will act as discussion leader.

Possible Resources

Mathematics for Everyday Life
Charles Merrill Company
a Bell & Howell Company
Columbus, Ohio 43216

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) The student knows that there are various types of automobile insurance available with distinct advantages based on age of insured, health and driving record.

State Goal	1
District Goal	
Program Goal	1,6

Related Area(s)

Suggested Activities: Grade(s) 12

Title:
Group Size: three or four students
Materials: charts summarizing costs of auto insurance for people with varied age, health and driving records (from local companies)

Procedure(s):

- Divide class into groups of three or four students.
- Each groups is to shop for auto insurance for a "person" (include age, driving record and health).
- Each group is to determine which company's insurance plan is cheapest for their "person". (All groups should be looking for the same kinds of coverage.)
- Get the class together.
- Each group describes their "person" briefly, states the cost of insurance, who they would get it through, and why.

Suggested Monitoring Procedures

Teacher will act as discussion leader.

Possible Resources

Consumer and Career Mathematics
Scott Foresman & Company
Glenview, Illinois 1978

Mathematics For Everyday Life
Charles Merrill Company
A Bell & Howell Company
Columbus, Ohio 43216

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
224		225

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that automobile insurance can include different kinds of coverage. B. The student is able to compare and select appropriate types of auto insurance.

State Goal 1
District Goal
Program Goal 1,6

Related Area(s)

Suggested Activities: Grade(s) 12	Suggested Monitoring Procedures	Possible Resources
Title: **Group Size:** four or five students (depends on class size and number of insurance plans) **Materials:** charts with kinds of coverages and costs from local insurance companies	Teacher will act as discussion leader.	Insurance Agents

Procedure(s):

- Divide the class into groups.
- Have each group determine the cost of insurance from a given insurance company (the kinds of coverage and person insured should be constant for each group).
- Bring class together.
- Compare the costs from the different companies and where they vary (kinds of coverages).

District Resources

226

227

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

228

229

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows homeowner's insurance covers buildings, personal property and household belongings. B. The student is able to compare and select appropriate type of homeowner's insurance.

Related Area(s)

State Goal	1
District Goal	
Program Goal	1,6

Suggested Activities: Grade(s) 12

Title:
Group Size: three or four students
Materials: charts with kinds of homeowner's coverages and their costs from local insurance companies

Procedure(s):

- Divide the class in groups.
- Give each group a home to insure including information about:
  - (1) location (flood or earthquake danger, theft danger)
  - (2) size of home
  - (3) valuable belongings
  - (4) location of nearest fire station
- Each group is to determine what types of coverage are necessary, what the total cost of insurance would be and what company would be least expensive.
- Get the class together.
- Each group briefly describes their home, types of coverages they feel are necessary, where to buy and what the cost would be.

Variation:

- Have students repeat the process with their own homes.

230

Suggested Monitoring Procedures

Peruse group results.

Possible Resources

Mathematics For Everyday Life
Charles Merrill Company
A Bell & Howell Company
Columbus, Ohio 43216

District Resources

231

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
232		
		District Resources
		233

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATIONS
Ratios, Proportion, Measurement Formulas, Percent

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. formulas to compute distance, area, perimeter, volume.	135-140	11-12					
The student is able to:							
. apply formulas for calculating perimeter, area, volume of common spaces, objects and containers.	135-140						
. solve practical word problems involving whole numbers, fractions, decimals, and percent: interest, commissions, percent of change, discount, price (see Rational Numbers K-8 Objectives pages 92-95).	141-147						
. use ratios, proportions and percent to increase, decrease, and relate measures of distance, cost, time, quantity, rate, weight, area, volume and temperature.	149-150						
The student values:							

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows formulas to compute distance, area, perimeter, volume. B. The student is able to apply formulas for calculating perimeter, area, volume of common spaces, objects and containers.

State Goal	1,2
District Goal	
Program Goal	1,2,6

Related Area(s)

Suggested Activities: Grade(s) 11-12	Suggested Monitoring Procedures	Possible Resources
Title: How much air? **Group Size:** two or three students **Materials:** tennis balls and containers **Procedure(s):** . Divide class into groups. . Give each group a container with three tennis balls inside. . Have each group calculate the volume of the air inside the can that isn't displaced by the balls.	Group those who are having difficulty and reteach.	**Applications in Mathematics (A.I.M)** Scott Foresman & Co. 1977 Palo Alto, CA
Title: Enough Air? **Group Size:** three or four students **Materials:** tape measures **Procedure(s):** . Divide class into groups. . Assign each group the task of finding the volume of a room. . Given the cubic feet of air necessary per person (300 cubic feet), how many people should be allowed in that room? . Get the class together, summarize the results and compare them to the number of people usually found in each room.	Teacher observation Discussion leader	Federal or state regulations.
		District Resources

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Suggested Activities: Grade(s) ________

Title:
Group Size: two students
Materials: several rectangular and cylindrical containers

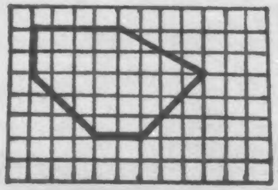
Procedure(s):

- Pair up all students in the classroom to compete against each other.
- Hold two containers in your hands to show all class members.
- Each student picks the container he feels is larger.
- Write the dimensions of each on the board and let each pair of students calculate the volume of each to determine which is larger.
- The students who guessed correctly score a point.
- Repeat as time permits or until a predetermined score is achieved by one member of each group.

Title:
Group Size: two or three students
Materials: graph paper, straight edge

Procedure(s):

- Divide the class into groups.
- Have each construct a polygon on the graph paper, with all line segments starting and ending at the intersection of two lines on the graph paper. They must also calculate the area.
- Have pairs of groups trade and compete to see who can calculate the opponent's area first.



Suggested Monitoring Procedures

Have extra problems ready.

Teacher observation.

Teacher observation.

Group those who have trouble and reteach.

Possible Resources

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows formulas to compute distance, area, perimeter, volume. B. The student is able to apply formulas for calculating perimeter, area, volume of common spaces, objects and containers.

Related Area(s)

State Goal	1
District Goal	
Program Goal	2,4,6

Suggested Activities: Grade(s) 11-12

Title: Measuring Wheel
Group Size: entire class
Materials: three inch plastic lids attached to one foot piece of lath at center of lid, i.e.,

Procedure(s):

- Have the students place a mark on the edge of the lid.
- Have students carefully roll the lid one revolution and measure the distance covered. (This should equal the circumference of the lid).
- Have the students divide this distance by three (diameter of lid). The answer should come out 3.1 or very close to it which is the approximate value of π.
- Have the students reverse the operation. (Students will find $\pi \cdot d = C$).

Variation

- For variety or extension of the activity, use a 26" bicycle tire attached to a bike fork, compute circumference of the tire in classroom, then have the students use tire as measuring wheel to measure the school parking lot, football field, etc.

Suggested Monitoring Procedures

Worksheet of problems with the student given the circumference of a circle and asked to find the radius; asked to find the diameter.

Possible Resources

District adopted text.

District Resources

Suggested Activities: Grade(s) ______

Title: Triangles and Parallelograms Compared

Group Size: individual, small group, entire class

Materials: rectangle cut from construction paper, parallelogram(s) cut from construction paper, scissors, ruler, pencil

Procedure(s):

- Have the students measure length and width of rectangle and calculate area of the rectangle ($A = lw$).
- Have students draw a diagonal; then have them carefully cut on diagonal.
- Have the students observe the shapes of the resulting figures and compare the two triangles. Ask students if the triangles are the same size.
- Ask students to compare the area of one triangle to the area of the rectangle.
- Have students repeat this process with parallelograms ($A = bh$).
- Ask students if a formula can be derived for the area of the triangle. ($A = \frac{1}{2}bh$)

Suggested Monitoring Procedures

Observation of students during the activity.

Give students a worksheet with figures of triangles and parallelograms. Have them indicate the formula to use when finding the area of each one. Have them compute the area using the formula they chose.

Possible Resources

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows formulas to compute distance, area, perimeter, volume. B. The student is able to apply formulas for calculating perimeter, area, volume of common spaces, objects and containers.

State Goal 1

District Goal

Program Goal 2,4,6

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Area, Area

Group Size: individual, small group, entire class

Materials: scissors, pencil, paste, graph paper (preferably two contrasting colors)

Procedure(s):

- Student receives a polygon drawn on graph paper.
- Also he/she receives a rectangle or square which has the same area as the polygon.
- Have the student calculate the area of the rectangle. Then cut the polygon on the lines into rectangles and squares. Fit and paste the pieces into the rectangle.
- Have the student calculate the area of each piece and sum the areas, showing the total area is equal to the sum of the partial areas.
- See diagrams on back of page.

Suggested Monitoring Procedures

Observation of students in the activity.

Give the students a worksheet with several problems on finding the area of a rectangle when given the length and width.

Vary the problems by having students solve problems when only the area and the length is given (find the width) or when the area and the width is given (find the length).

Possible Resources

District adopted text.

District Resources

Suggested Activities: Grade(s) ______

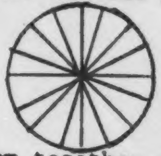
Title: Area of a Circle by Visual Aid

Group Size: individual, small group, entire class

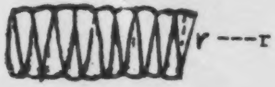
Materials: circle of given radius as shown below, scissors, worksheet

Procedure(s):

- Review radius (r), circumference (c), area of parallelogram (A = bh), ≈ means one number is approximately equal to another.
- Have students cut out parts of the circle.



and put them together as a parallelogram.



1/2xc

- Explain:

Area of parallelogram = b x h since $h \approx r$
= b x r since $b \approx \frac{1}{2}c$
= $\frac{1}{2}$ x c x r since $c = 2\pi r$
= $\frac{1}{2}$ x 2 x π r x r
= 1 x π x r x r
= πr^2 since area of parallelogram = area of circle

Suggested Monitoring Procedures

Observation of the activity.

Check worksheets and group students needing additional help.

Possible Resources

District adopted text.

ESD 189 film F1627 "Developing the General Equation of a Circle"

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to solve practical word problems involving whole numbers, fractions, decimals and percent: interest, commissions, percent of change, discount and price.

State Goal	1
District Goal	
Program Goal	2,4,7

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Fraction Sets
Group Size: small group, entire class
Materials: large calendar, classroom objects

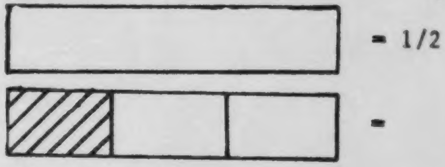
Procedure(s):

- Display a large calendar and compare a school week with a calendar week. Express this as a fraction and label the fraction, i.e.,
  $\frac{5}{7}$ - school week - Numerator
  calendar week - Denominator
- Repeat this process using other examples from the calendar, i.e., Mondays as compared to all the weeks all the days in the month, etc..
- Give students a worksheet and ask the following questions to be expressed as a fraction.
  What fraction of the days of the week begins with: W, T, M, S
- Give students a series of fractions on the worksheet such as 1/2, 3/4, 5/6, etc.. Have them circle the fractions that have a numerator of 3; cross out the fractions with a denominator of 6. (Vary with different combinations.)

Title: Fraction the Fractions
Group Size: small group, entire class
Materials: worksheet

Procedure(s):

- Fill in the missing portions of each equivalent.



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Suggested Monitoring Procedures

Peruse worksheets.

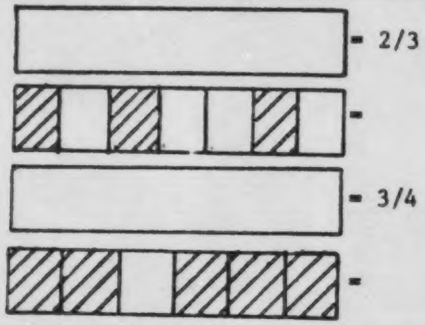
Possible Resources

District adopted text

District Resources

218

Suggested Activities: Grade(s) ______



Title: Spot the Sets
Group Size: small group, entire class
Materials: worksheet

Procedure(s):

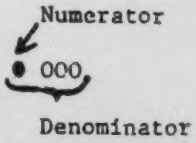
. Make a fraction that compares the shaded circle to the total number of circles in the set, or shade in the set to make it equivalent to the fraction.

Example:

(● O O O) = 1/4
(O O O O) =
(O O O O O) =
(● O O O ● O) =
(● ● ● ● ● ●) =
(O O O O O O) = 2/6
(O O O O O O O) = 0/7

Suggested Monitoring Procedures

Give students a worksheet with sets similar to the activity and have them work the problems. In addition, have them label the numerator and the denominator in the set, i.e.,



Possible Resources

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to solve practical word problems involving whole numbers, fractions, decimals and percent: interest, commissions, percent of change, discount and price.

State Goal	1
District Goal	
Program Goal	2,4,7

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Percent Concentration
Group Size: pairs
Materials: concentration board, 16 cards with 8 of one color and 8 of another.

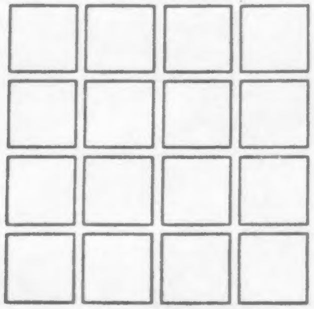
Procedure(s):

- Make up eight cards with rational numbers and eight cards of another color as percentages.
- Place the cards face down on the board. The first player draws a card of each color. If the rational number card and the percentage card match, the player gets one point and draws two more cards.
- If the cards do not match, they are placed face down and the other player gets a turn.
- The winner is the player with the highest total.

Example:

.05	.5	$\frac{3}{4}$	2	$1\frac{1}{2}$	3	.6	.25
5%	50%	75%	200%	150%	300%	60%	25%

CONCENTRATION



Game Board

Suggested Monitoring Procedures

Possible Resources

District adopted text

District Resources

Suggested Activities: Grade(s) ______

Title: Clearance Sale
Group Size: entire class
Materials: large pictures of items students might like, i.e., ski equipment, stereo equipment.

Procedure(s):

- Attach regular sales prices to each item.
- Teacher puts pictures with prices on the bulletin board along with a sign saying "Clearance Sale -- 20% Off!"
- Give students a fixed amount of money to spend.
- Students are to decide which items they could buy with their money.

Given $150, which of these could you buy?

Item	Regular Price	20% Off
ski boots	$95.00	
ski jacket	45.00	
ski mask	12.00	
ski gloves	8.00	
stereo	145.00	
stereo headphones	35.00	
speakers	90.00 each	
turntable	130.00	

Suggested Monitoring Procedures

Paper and pencil check with similar items.

Possible Resources

District adopted text.
magazines
newspapers

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to solve practical word problems involving whole numbers, fractions, decimals and percent: interest, commissions, percent of change, discount and price.

State Goal	1
District Goal	
Program Goal	2,4,7

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title:
Group Size: three students
Materials:

Procedure(s):

- Divide the class into groups.
- Provide the following chart:

	Item A	Item B	Item C
Unit Price	$619.	$339.	$129.
% Commission	10%	15%	20%
Number Sold Per Day	2	3	5

- Each group is to figure which item, being sold exclusively, would net $1,000. in commission first.

Suggested Monitoring Procedures

Give students additional problems to calculate commission.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______

Title: Shopping Tournament
Group Size: two students
Materials:

Procedure(s):

- Divide class into pairs. The two students compete against each other (flip a coin to see who gets first choice between % discount and discount price).
- State the price of an object, a percent of discount and discounted price.

PRICE = $675.
% DISCOUNT = 20%
DISCOUNT PRICE = $649.

- Students choose which is the best deal, the % discount or discount price (quick decision with no calculation allowed).
- Calculate which is the best deal.
- Repeat until one student in each pair wins three times (best 3 of 5 with first choice alternating each time).
- After five items the losers drop out while the winners are paired up and play a new best 3 of 5.
- Repeat until one student is the champion.

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Suggested Monitoring Procedures

Conduct tournament by pairing winners and losers.

Possible Resources

District Resources

258

Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to solve practical word problems involving whole numbers, fractions, decimals and percent: interest, commissions, percent of change, discount and price.

State Goal	1
District Goal	
Program Goal	2,4,7

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Base x Rate = Percentage
Group Size: entire class
Materials: worksheet in chart form, overhead or chalkboard.

Procedure(s):

- Review with students that percent means "per hundred." Demonstrate that in order to use percents in computation, it is necessary to change percents to decimals:
  $60\% = \frac{60}{100} = 60 \div 100 = .60$
- Point out that in basic percent problems students can replace percents by decimals in order to multiply:
  20% of $8 = .20 \times 8 = 1.6$
- Use terms for the percent problem as follows:
  $20\% = .20$ is the ratio or rate.
  8 is the base
  1.6 is the percentage of the base. Thus, rate times base equal percentage ($r \times b = p$).
- Go over several examples with students and then have them fill in the chart:
  30% of 50 is ___
  $.30 \times 50 = p$
  $.3 \times 50 = p$
  $.3 \times 50 = 15$

PERCENT PROBLEM	PERCENTAGE	RATE	BASE
8% of 75 is 6	6	.08	75
25% of 56 is ___			
___ is 25% of 56			
80% of 90 is ___			
___ of 50 is 40			

Suggested Monitoring Procedures

Evaluate the chart.

Possible Resources

District adopted text

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
261		262

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Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to use ratios, proportions and percent to increase, decrease, and relate measures of distance, cost, time, quantity, rate, weight, area, volume and temperature.

State Goal 1,2

District Goal

Program Goal 1,2,6

Related Area(s)

Suggested Activities: Grade(s) 11

Title:
Group Size: individual
Materials: chart showing weight changes between planets

Procedure(s):

- Present students with a chart comparing the weight of an object on different planets.

Planet	% of earth weight
Earth	100%
Mercury	38%
Venus	87%
Mars	39%
Jupiter	265%
Saturn	117%
Uranus	105%
Neptune	123%
Pluto	?

- Have each student calculate what his body weight would be on each planet.

Suggested Monitoring Procedures

Reteach if necessary.
Quiz with a different weight.

Possible Resources

Mathematics for the Real World
Charles Merrill Publishing Co.
A Bell & Howell Company
Columbus, Ohio 43216

Mathematics for Everyday Life
Charles Merrill & Co.
A Bell & Howell Co.
Columbus, Ohio 43216

District Resources

Suggested Activities: Grade(s) ________

Title: How Far?
Group Size: individual
Materials: map drawn to scale, ruler

Procedure(s):

- Give students a map, ruler and a list of locations on the map.
- The students are to find the actual distance from these locations to a given point.

Title: Best Buy?
Group Size: individual
Materials: worksheet with various items and prices

Procedure(s):

- Give students a list of items, each with the price given in at least two ways:

Special Flashcubes	
package of 3	$1.59
3 packages	$4.49
12 packages	$19.19

- Students are to figure out the best deal for each item.

Suggested Monitoring Procedures

Group students who are having trouble and reteach.

Group students who are having difficulty and reteach.

Possible Resources

Mathematics for the Real World

Mathematics for Today
Activities in Mathematics
proportions - second course
Oxford Book Company
Los Angeles, Calif.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: PRACTICAL APPLICATIONS

Use of Calculators	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that electronic calculators are economically useful tools in solving everyday problems.	153-158	11-12					
. the importance of estimating before working problems using an electronic calculator.	157						
The student is able to:							
. do fundamental operations using a calculator (+,-,X,÷).	153						
. perform a series of arithmetical operations using a calculator to solve everyday problems.	155						
. use estimation in checking problems using a calculator.	157						
The student values:							
. the skill of estimation.							

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Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that electronic calculators are economically useful tools in solving everyday problems. B. The student is able to do fundamental operations using a calculator (+, -, X, ÷).

State Goal	1,4,10
District Goal	
Program Goal	1,5,6

Related Area(s)

Suggested Activities: Grade(s) 11

Title: Magic Squares
Group Size: individual
Materials: calculators

Procedure(s):

- Give students a partially completed magic square (3x3, 4x4, 5x5 involving addition or multiplication).

2		
	5	1
		8

- Using a calculator to speed up the arithmetic, the students are to complete the magic square.

Title:
Group Size: individual
Materials: calculators

Procedure(s):

- Give each student a calculator and some partially completed times tables.

X	21		24
		208	
	399		
23		368	552

- Have each student fill in the empty boxes.

Suggested Monitoring Procedures

Give students additional partially completed magic squares with varied numbers and operation.

Possible Resources

Funtastic Calculator Math
ENRICH, INC.
Sunnyvale, CA. 94086

Problem Solving with Calculators
The Math Learning Center
c/o David Moursend
2420 Olive Street
Eugene, Ore. 94705

Using the Mini-Calculators to Teach Mathematics
The School District of Philadelphia

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that electronic calculators are economically useful tools in solving everyday problems. B. The student is able to perform a series of arithmetical operations using a calculator to solve everyday problems.

State Goal	1,4,10
District Goal	
Program Goal	1,5,6

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title:
Group Size: two or three students
Materials: calculators

Procedure(s):

- Divide class into groups of two or three students.
- Give students a beginning balance for savings and checking accounts and a list of transactions.
- Each group of students is to use a calculator to figure the ending balance in each account.
- As a class, discuss some of the ways the calculator was used (memory) and some of the mistakes made.

Suggested Monitoring Procedures

Teacher observation.

Teacher acts as discussion leader.

Possible Resources

Calculator Instruction Booklets

Texas Instruments teaching materials on the calculator

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
274		275

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Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows the importance of estimating before working problems using an electronic calculator. B. The student is able to use estimation in checking problems using a calculator.

State Goal	1,4,10
District Goal	
Program Goal	1,5,6

Related Area(s)

Suggested Activities: Grade(s) 11

Title:
Group Size: individuals
Materials: calculators

Procedure(s):

- Pair students to compete against each other.
- State an arithmetic problem.
- Each student is to estimate the answer using only one non-zero digit.
- Have each student use a calculator to find the actual answer.
- The student whose estimate is closest scores one point.
- The first student of each pair with two points wins.
- The losers drop out while the winners are paired.
- Repeat the process.

Suggested Monitoring Procedures

Conduct tournament.

Make students write estimates on paper.

Possible Resources

Calculators, Computers
DYMAX
P. O. Box 310
Menlo Park, CA. 94025

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Language of Algebra - Sets and Symbols

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows: . symbols commonly used in the study of elementary algebra. . how to order the real numbers on the number line.		8-10					
The student is able to: . identify: elements, subsets, intersection of sets, union of sets, empty sets, equivalent sets, infinite sets, finite sets, disjoint sets, complement of sets. . specify sets by roster, rule and graphing. . express the relationships of sets through Venn diagrams.	161						
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 8-10

Student Learning Objective(s) The student is able to identify: elements, subsets, intersection of sets, union of sets, empty sets, equivalent sets, infinite sets, finite sets, disjoint sets, complement of sets.

State Goal	1
District Goal	
Program Goal	2,3

Related Area(s)

Suggested Activities: Grade(s) 8-9

Title: Set Identification
Group Size: small team (4-5)
Materials: paper, pencil, index cards - each card containing a number of sets specified by roster. A list of all terms to be identified.

Procedure(s):

- Each team selects a card.
- The team records on paper an example of each of the terms, such as intersection, subset, union, that deal with sets they can find in the sets on their card.
- Team receives one point for each correctly identified example.
- Cards are exchanged after a set time (e.g. 3 min.).
- After all cards have been used, team with most points is the winner.

Example:

Card

$A = \{2,3\}$

$B = \{3,4\}$

$C = \{3\}$

$D = \{2,3,4\}$

$E = \{5,6,7,...\}$

(continued on back)

Suggested Monitoring Procedures

Teacher evaluates each teams' responses and assigns the teams' score.

Possible Resources

Dolciani, Mary P., et al, Algebra, Structure and Method Book 1, Houghton Mifflin & Co., Palo Alto, CA, 1979

District Resources

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Suggested Activities: Grade(s) ______

Response

elements	2, 3, 4, 5, . . .
subset (Proper only)	$C \subseteq B$, $C \subseteq A$ $C \subseteq D$, $A \subseteq D$, B D
intersection	$A \cap B = C$ $A \cap D = A$
union	$A \cup B = D$ $A \cup D = D$
disjoint sets	A & E B & E C & E D & E
finite sets	A, B, C, D
infinite sets	E
equivalent sets	A & B

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Suggested Monitoring Procedures

Possible Resources

District Resources

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SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA
Variables, Open Sentences and Evaluating Expressions

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. meaning of variable, constant, coefficient, exponent, term base, solution set, symbols of inclusion and open sentences.	165	8-10					
The student is able to:							
. simplify rational algebraic expressions.							
. evaluate algebraic expressions by substitution of variable	165-166						
. simplify expressions containing symbols of inclusion.							
. add, subtract, multiply and divide rational algebraic expressions.							
. translate a verbal problem into an algebraic expression.							
The student values:							

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Suggested Objective Placement 8-10

Student Learning Objective(s) A. The student knows the meaning of variable, constant, coefficient, exponent, term base, solution set, symbols of inclusion and open sentences.

B. The student is able to evaluate algebraic expressions by substitution of variable.

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

Suggested Activities: Grade(s) 9-10

Title: Expression Solving Race
Group Size: class
Materials: small sheets of scratch paper

Procedure(s):

- Divide class up into equal rows.
- Each row is a team.
- Each player needs scratch paper to solve his or her expression and a small sheet of paper to pass their answer back.
- On board write an expression.
- Give the first person in each row a small sheet of paper with a number to be substituted in the expression on it.
- Give the command to begin.
- First person in each row turns over sheet of paper and solves expression.
- When first person is finished he writes his answer on another small sheet of paper and passes it to the student behind.
- Next student follows same procedure.
- First row to finish with correct answer wins.

Example (over)

Suggested Monitoring Procedures

Teacher observation and guidance.

Possible Resources

Applications in Mathematics
Scott, Foresman and Company, 1972

District Resources

The previous numbered page in the original document was blank

Suggested Activities: Grade(s) _______

Suggested Monitoring Procedures

Possible Resources

Expression (2x-1)

	Row 1	Row 2	Row 3	Row 4	Row 5
	Let X=-1	Let X=0	Let X=2	Let X=1	Let X=3
1st	2x-1=-3	2x-1=-1	2x-1=3	2x-1=1	2x-1=5
2nd	2x-1=-7	=-3	=5	=3	=11
3rd	2x-1=-15	=-7	=11	=5	=21
4th	=-31	=-15	=21	=11	=41
5th	=-63	=-31	=41	=21	=81
Answer	-63	-31	41	21	81

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District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA
Axioms of Addition and Multiplication of Real Numbers

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the additive and multiplicative (reciprocal) inverses of real numbers.	169	8-10					
. the identity elements of real numbers.							
The student is able to:							
. identify the axioms of closure and equality and the commutative, associative and distributive axioms.							
. identify the additive and multiplicative inverses of algebraic expressions.	169						
. determine the absolute value of a real number.							
The student values:							

Suggested Objective Placement 8-10

Student Learning Objective(s) A. The student knows the additive and multiplicative (reciprocal) inverses of real numbers. B. The student is able to identify the additive and multiplicative inverses of algebraic expressions.

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

Suggested Activities: Grade(s) 9-10	Suggested Monitoring Procedures	Possible Resources
Title: Team Inverses **Group Size:** entire class **Materials:** chalkboard or worksheets	Teacher evaluates responses, assigns scores.	Dolciani, Mary P., et al, Algebra, Structure and Method Book 1, Houghton Mifflin Co., Palo Alto, CA 1979

Procedure(s):

- Divide class into 4, 5, or 6 equal teams.
- One person from each team goes to board.
- Give algebraic expression.
- Students must write additive and multiplicative inverses on board. Time limit (10-20) seconds.
- Each correct answer +1, total of +2.
- Each incorrect answer -1, total of -2.
- Team with highest score wins.

Example:

- Call out $3x$
- Additive inverse $-3x$

Multiplicative $\frac{1}{3x}$

District Resources

The previous numbered page in the original document was blank

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
293		294

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Single Variable Equations and Inequalities

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. how to add, subtract, multiply and divide real numbers.	173- 176	8-10					
The student is able to:							
. solve single variable equations and inequalities.	173 176						
. use single variable equations or inequalities to solve verbal problems.							
. graph solution sets of single variable equations and inequalities.							
. combine inequalities and graph their solution set.							
The student values:							

Suggested Objective Placement 8-10

Student Learning Objective(s) The student knows how to add, subtract, multiply and divide real numbers. B. The student is able to solve single variable equations and inequalities.

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

Suggested Activities: Grade(s) 9

Suggested Monitoring Procedures

Possible Resources

- If the question is answered correctly, the player receives the money alloted to that question.
  Note: Gameboard
- The players choose categories in turn after each question is successfully answered.
- The player with the most money after all questions have been answered is the winner.

Example of Jeopardy Gameboard:

	+	-	-	x	2 step problem
$10	$x+1 = 5$	$x-1= 9$	$\frac{x}{2} = 4$	$2y = 6$	$2x+1 = 7$
$20	$x+2 = 8$	$x-5= 31$	$\frac{x}{3} = 7$	$4z = 28$	$3x-1 = 8$
$30	$x+10 =25$	$x-8= 64$	$\frac{x}{9} = 8$	$7n = 49$	$\frac{x}{4} +2 = 4$
$40	$x+10=154$	$x-10=110$	$\frac{x}{12} = 15$	$12x = 144$	$\frac{y}{7} +1 = 9$
$50	$x+9=148$	$x-8= 60$	$\frac{x}{17} = 24$	$13X = 139$	$4x+8 = 9$

- Note: To solve an equation that has addition or subtraction, the addition property of equations is used. To solve an equation that has multiplication or division, the multiplication property of equations is used.

District Resources

The previous numbered page in the original document was blank.

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 8-10

Student Learning Objective(s) A. The student knows how to add, subtract, multiply and divide real numbers. B. The student is able to solve single variable equations and inequalities.

State Goal 1,8

District Goal

Program Goal 6,8

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Kentucky Derby (Roller Derby; Indy 500)

Group Size: small groups (teams of 4-5)

Materials: chalkboard or transparency, toy horses or cards, 3 x 5 cards on which problems have been written

Procedure(s):

- A team advances its horse by correctly solving problems.
- A correct answer moves the horse to the next furlong marker.
- The game can be made to fit the interests of the class just by changing the name to "Roller Derby" or "Indy 500." The same rules apply except that laps are counted instead of furlongs.
- An arbitrary number of laps may be set at the discretion of the teacher.

Addition example:

$$\boxed{\begin{array}{l} b - 3 = 8 \\ b = \end{array}} \qquad \boxed{\begin{array}{l} x - \frac{1}{8} = 2\frac{3}{8} \\ x = \end{array}}$$

Multiplication example:

$$\boxed{\begin{array}{l} \frac{x}{3} = 5 \\ x = \end{array}} \qquad \boxed{\begin{array}{l} \frac{b}{12} = 6 \\ b = \end{array}}$$

Suggested Monitoring Procedures

Worksheet with equations using the addition principle and the multiplication principle.

Students having difficulty with the worksheet should be grouped for reteaching.

Possible Resources

District Resources

Suggested Activities: Grade(s) _______

Title: What's My Pattern?
Group Size: entire class
Materials: written exercise as below

Equation	Number to be added
$x - 2 = 8$	5
$x - 5 = 4$ - - - - - - - - - - - - -	2
$x - 9 = 1$	1
$x - 1 = 4$	4
$x - 4 = 8$	9

Procedure(s):

- Ask the students to draw a dotted line matching the number that must be added to both members of each equality in order to solve the equation.
- One example has been done for you.
- After all equations have been matched with a number on the right, study the problems to determine what pattern has developed.
- What pattern has developed?

Suggested Monitoring Procedures

Check written exercise and pair students having difficulty with more able students for assistance and drill.

Possible Resources

District adopted text

District Resources

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Suggested Objective Placement ________

Student Learning Objective(s) ______	State Goal ☐
______	District Goal ☐
______	Program Goal ☐

Related Area(s) ______

Suggested Activities: Grade(s) _____	Suggested Monitoring Procedures	Possible Resources
See small schools math curriculum grades 7-8 page 143 for additional activities.		
		District Resources

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Suggested Activities: Grade(s) ________	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Polynomials

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the rules of exponents, e.g.: $b^m b^n = b^{m+n}$ $\frac{b^m}{b^n} = b^{m-n}$ $b^{-m} = \frac{1}{b^m}$ $b^o = 1$	181-184	8-10					
The student is able to:							
. identify monomial, binomial, trinomial and polynomial.							
. determine the degree of a monomial.							
. determine the degree of a polynomial.							
. add, subtract, multiply and divide polynomials.							
. factor a polynomial, e.g.: common monomial difference of squares perfect square trinomial general trinomial	185						
. identify common monomial factors.							
. solve polynomial equations by factoring.							
. solve verbal problems by use of factoring techniques.							
. apply rules of exponents for a power of a power, e.g., $(b^m)^n = b^{mn}$							
The student values:							

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Suggested Objective Placement 8-10

Student Learning Objective(s) The student knows the rules of exponents, e.g., $b^m b^n = b^{m+n}$, $\frac{b^m}{b^n} = b^{m-n}$, $b^{-m} = \frac{1}{b^m}$, $b^0 = 1$

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

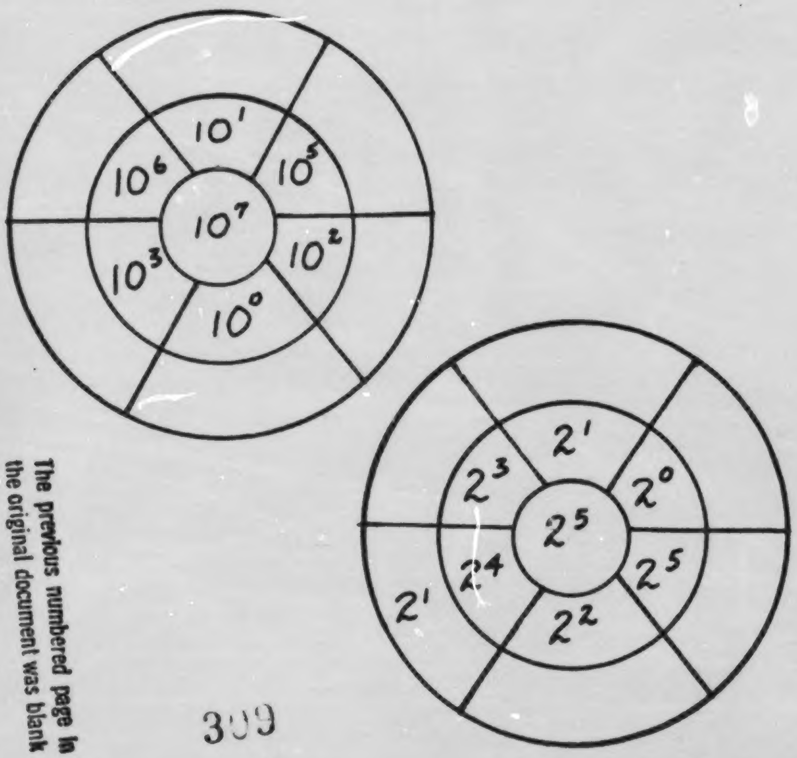
Suggested Activities: Grade(s) 9

Title: Division Wheels (Exponents)
Group Size: entire class
Materials: division wheels

Procedure(s):

- Complete each division wheel by expressing each quotient as a single digit.

Example:



Suggested Monitoring Procedures

Teacher observation. Group students having difficulty with the concept for reteaching.

Possible Resources

District adopted text

District Resources

The previous numbered page in the original document was blank

Suggested Activities: Grade(s) _______

Title: Bingo

Group Size: entire class

Materials: Bingo gameboard as shown below, markers, multiplication and division involving numerical expressions with exponents

Procedure(s):

- The caller reads the multiplication and division problems using exponents.
- For example, one card might read "B3 squared times 3 to the fourth power". CELL B3 has 3^6 on it. A marker is placed on that cell.
- A second card might read "02 to the eighth power divided by 2 squared." Cell 03 has 2^6 on it.
- The first player who covers a horizontal, vertical, or diagonal straight line wins.

Sample Card:

1	4^3	8^7	3^3	9^6	8^5
2	5^2	2^3	5^5	4^2	9^4
3	3^6	2^4	free	3^4	2^6
4	6^2	2^2	5^3	7^2	2^5
5	7^4	2^6	6^5	6^3	8^2
	B	I	N	G	O

Suggested Monitoring Procedures

Possible Resources

District Resources

Suggested Objective Placement 8-10

Student Learning Objective(s) The student knows the rules of exponents, e.g., $b^m b^n = b^{m+n}$, $\frac{b^m}{b^n} = b^{m-n}$, $b^{-m} = \frac{1}{b^m}$, $b^0 = 1$

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

Suggested Activities: Grade(s) 9	Suggested Monitoring Procedures	Possible Resources
		District adopted text

Title: Ordering Integers with Negative Exponents

Group Size: entire class

Materials: a set of integers with negative exponents

Procedure(s):

- Tell the students that they are to be given a set of integers with negative exponents that they are to order according to size, the largest on the left and the smallest on the right.
- Visual inspection will probably be a very slow and difficult method of ordering the terms.
- What action should you take in order to make your task easier? (Answer: Write the inverse of each term for ease of ordering.)
- Example: Set to order:

$3^{-2}, 5^{-3}, 10^{-2}, 4^{-3}, 2^{-4}, 6^{-2}$

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

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Suggested Objective Placement 8-10

Student Learning Objective(s) The student is able to factor a polynomial, e.g.: common monomial, difference of squares, perfect square trinomial, general trinomial.

State Goal	1,8
District Goal	
Program Goal	6,8

Related Area(s)

Suggested Activities: Grade(s) 9-10

Title: Factoring Jeopardy
Group Size: 2-5 students
Materials: Jeopardy Gameboards
Monopoly money, etc. to keep "score" with.

Procedure(s):

- The "moderator" pays and receives "money" or points from the participants after a question is answered correctly or incorrectly.
- The game is begun by a player choosing a category and the moderator writing the polynomial on chalkboard or exposing it on gameboard. The player gets one change within a short time (30 seconds) to state the correct factoring of the polynomial. If the player is correct, the moderator pays the stated amount of money to him. If incorrect the player pays the moderator and another player can volunteer an answer.
- The players choose categories in turn after each question is successfully answered.
- The player with the most money after all questions have been answered is the winner.

(Examples of Gameboard on back side.)

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Suggested Monitoring Procedures

Choose student "moderators" to run game. If all participants miss a problem, the moderator can demonstrate the solution.

Teacher observation and guidance.

Possible Resources

District Resources

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Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

Example of Gameboard

Category	Common Monomial	Difference of two squares	Perfect square trinomial	$ax^2=6x+c$ with a=1	ax^2+6x+c with a+1
$10	$2x+4$	X^2-4	X^2+4X+4	X^2+5X+6	$2X^2+3X+1$
$20	X^2+2X	X^2-Y^2	$X^2+2XY+Y^2$	$X-7X+10$	$2X^2+5X+2$
$30	$2X^3+X^2$	$4X^2-49$	$4X^2-12XY+9Y^2$	$X^2-3XY-10Y^2$	$2X^2+7X+6$
$40	$3X^3+6X^2+9X$	$16X^2-25Y^2$	$25X^2-120X+144$	X^2-X-20	$6X^2-5X-6$
$50	$X^5Y^4-X^2Y^5$	$X^4Y^2-9Z^2$	$X^4Y^2-4X^2YZ+4Z^2$	$X^2-12XY-20Y^2$	$9X^2-3X-20$

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Rational Expressions and Open Sentences

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. how to reduce rational numbers to lowest terms.		8-10					
. how to find lowest common denominators for rational numbers.							
. division by zero is undefined.							
. definition of ratio, proportion and percent.							
The student is able to:							
. add, subtract, multiply and divide rational algebraic expressions.	189-190						
. simplify complex functions.							
. solve fractional equations and inequalities.							
. solve problems involving ratios, proportions and percents.							
The student values:							

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SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 8-10

Student Learning Objective(s) A. The student is able to add, subtract, multiply and divide rational algebraic expressions. B. The student is able to solve fractional equations and inequalities.

State Goal 1

District Goal

Program Goal 6,7,8

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Hollywood Squares (Tick Tack Toe)

Group size: Whole class (11 at one time)

Materials:

Procedure(s):

- Draw a 3 by 3 square and put the names of nine students (to be the stars) in the boxes.
- Select two players from the class. One is called X and the other is called O (cannot be one of the students in boxes).
- Player who goes first selects a box. (X Player)
- Host (teacher) asks question.
- Star (student) in box that was selected answers question (one minute time limit).
- Player states whether answer is true or false.
- If player is right an X or O is placed in that box.
- First player to get three across, up & down, or diagonally wins.

Example: 1,2,3,...9 would be names of stars(students).

1	2	3
4	5	6
7	8	9

(continued on back)

Suggested Monitoring Procedures

Possible Resources

District Resources

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Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

- 1st player X chooses Box 5.

  question: $\frac{7}{2x} + \frac{5}{2x}$ = what

  No 5's answer $\frac{4}{x}$

  Player X says that is false.
  Box 5 is filled with an X.

- 2nd player 0 chooses box 3.

  question: $\frac{y^2}{y-1} - \frac{1}{y-1}$ = what

  No 3's answer $y + 1$

  Player 0 says that is false but is incorrect, so in Box 3 you place an X.

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District Resources

325

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Graphs - Functions and Relations

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. the meaning of coordinates in a plane.		8-10					
. how to graph ordered pairs.	193						
. there is a one to one correspondence between the set of real numbers and set of points on a number line.							
. there is a one to one correspondence between the set of points in a plane and ordered pairs of numbers.							
The student is able to:							
. identify relations and functions including their domain and range.	195						
. graph linear equations in two variables.	193						
. determine the slope and y-intercept.							
. determine the equations of lines from points and slopes.							
. graph quadratic relations.							
. graph inverse variation.							
. use inverse variation to solve problems.							
The student values:							

Suggested Objective Placement 8 - 10

Student Learning Objective(s) A. The student knows how to graph ordered pairs.

B. The student is able to graph linear equations in two variables.

State Goal :
District Goal
Program Goal 6,7,8

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Graph-a-Picture
Group Size: entire class
Materials: graph paper, pencil, list of equations and conditions to be graphed

Procedure(s):

- The students will graph several line segments from linear equations and limits onthe variables. (e.g., $y = 2x - 3$ for $o \leq x \leq 2$).
- All will be graphed on the same coordinate system on an entire sheet of graph paper. If done correctly a picture, map, or design of teachers manufactor will result.

Example:

- The following has been copied exactly from Midwest Publications. Amusements in Developing Algebraic Skills, Vol. 1, page 46.

Example - *
Graph all of the following on same axis.

1. $\{(X,Y): Y = -20x + 21, 1 \leq x \leq 1\tfrac{1}{2}\}$
2. $\{(X,Y): Y = 13x + 144\tfrac{1}{2}, 10\tfrac{1}{2} \leq x \leq 11\}$
3. $\{(X,Y): X = 1, 1 \leq Y \leq 8\}$
4. $\{(X,Y): Y = 16, -1\tfrac{1}{2} \leq x \leq 7\tfrac{1}{2}\}$
5. $\{(X,Y): Y = 18x + 109, -6 \leq x \leq -5\tfrac{1}{2}\}$
6. $\{(X,Y): Y = 9, 1\tfrac{1}{2} \leq x \leq 3\}$

Suggested Monitoring Procedures

Teacher assists in graphing the first few segments.

Observe and evaluate student progress.

Possible Resources

*Amusements in Developing Algebraic Skills, Vol. 1
Clack, Alice A., Letich, Carol H., Midwest Publ. Co., Troy, Michigan, 1975

District Resources

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Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

Example -

7. $\{(X,Y): X = 3, -9 \leq y \leq -8\frac{1}{2}\}$
8. $\{(X,Y): Y = 10, -5\frac{1}{2} \leq x \leq 8\frac{1}{2}\}$
9. $\{(X,Y): Y = 16x + 40, -2 \leq x \leq -1\frac{1}{2}\}$
10. $\{(X,Y): Y = -16x + 136, 7\frac{1}{2} \leq x \leq 8\}$
11. $\{(X,Y): Y = 8, -2 \leq x \leq 10\frac{1}{2}\}$
12. $\{(X,Y): Y = -\frac{1}{20}x + \frac{19}{20}, 1 \leq x \leq 11\}$
13. $\{(X,Y): Y = \frac{-1}{16}x - 8\frac{11}{16}, 3 \leq x \leq 11\}$
14. $\{(X,Y): Y = 1, -6 \leq x \leq 1\}$
15. $\{(X,Y): Y = -\frac{189}{20}x + \frac{1919}{20}, 10 \leq x \leq 11\}$

Clue: 8% of the United States

Solution: Graph traces a map outline of Wyoming, Utah, Colorado, New Mexico.

District Resources

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Suggested Objective Placement 8 - 10

Student Learning Objective(s) The student is able to identify relations and functions including their domain and range.

State Goal 1

District Goal

Program Goal 6,7

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Find the Function
Group Size: entire class
Materials: overhead projector or chalk board

Procedure(s):

- Place an IN, OUT chart on board or overhead.

  IN/OUT

- Have students provide the IN (domain) number. and place on chart.
- Teacher places the correct OUT (range) number on chart.
- After two or more pairs of IN and OUT numbers are on chart ask students to determine the function or relation. If no response continue with IN, OUT numbers until correct function is found.

Example: Function is $y = x^2$

Place on board or overhead

IN	OUT
2	4
5	25
4	16

- Ask students for IN numbers. After each OUT number is placed on chart ask students to give function that fits.

Suggested Monitoring Procedures

Teacher uses the overhead.

Guidance by instructor.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

Students:
No. 1 gives 2
No. 2 gives 5
No. 3 gives 4

A student calls "$y = x^2$"; correct, go to next function.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Systems of Linear Equations - Two Variables	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
The student is able to: . solve systems of equations by graphing, by addition and by substitution. . use systems of equations to solve problems. . graph systems of inequalities.	199-201	8-10					
The student values:							

Suggested Objective Placement 8 - 10

Student Learning Objective(s) The student is able to solve systems of equations by graphing, by addition, and by substitution.

State Goal 1,8

District Goal

Program Goal 4,5,8

Related Area(s)

Suggested Activities: Grade(s) 9

Title: Group Solution of Systems Relays

Group Size: 3 students

Materials: paper, pencil, systems of equations to be solved.

Procedure(s):

- The students in a group will take turns doing various parts of the solution of a system. The first group to solve the system correctly, is the winner.
- The teacher gives first student in each group the system to be solved. The first student chooses the method of solution (addition or substitution) and passes on to the second student who proceeds with the solution as follows: If the method is addition the second student proceeds to the point where two equations are added together eliminating one of the variables. 2nd student then passes the problem on to the 3rd student or final solution.
- If the method is to be substitution the 2nd student picks the equation solved for one of the variables and passes on to the third student to complete the solution.

Suggested Monitoring Procedures

Teacher presents problems, points out that different approaches lead to easier solutions of systems. i.e., some systems lend themselves to easier solution by substitution, others by addition. Teacher points out pitfalls that groups get themselves into, i.e., increased calculation, fractions or decimals instead of integers.

Possible Resources

Johnson, Donovan A., et al, Activities in Mathematics, Second Course, Scott, Foresman and Co., Palo Alto, CA, 1971

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 8 - 10

Student Learning Objective(s) The student is able to solve systems of equations by graphing, by addition and by substitution.

State Goal 1, 8

District Goal

Program Goal 4,5,8

Related Area(s)

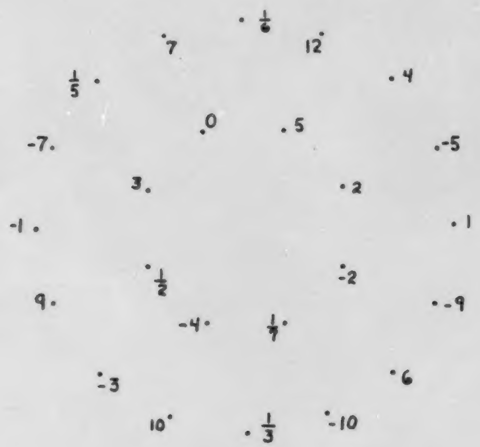
Suggested Activities: Grade(s) 9 - 10

Title: Connect the Answers
Group Size: entire class
Materials: worksheets for entire class

Procedure(s):

- Do some examples.
- Pass out worksheets.

SYSTEMS OF LINEAR EQUATIONS



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Suggested Monitoring Procedures

Teacher observation and assistance.

Possible Resources

Worksheet taken from Amusements in Developing Algebra Skills, by Alice A. Clack and Carol H. Letich, Midwest Publication Co., Inc. P.O. Box 129, Troy, Michigan 48084, 1975

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources

Connect the "x" and "y" answers for each problem.

1. $2x + 3y = 7$
   $-2x + y = 1$
2. $x + y = 2$
   $x - y = -4$
3. $7x + y = 7$
   $7x - y = -5$
4. $y = 3x + 13$
   $x + y = 1$
5. $5x + 7y = 1$
   $y = 10x - 2$
6. $x - 7y = -9$
   $14y = -7x$
7. $3x + 4y = -1$
   $x + 2y = -3$
8. $2x + 5y = -14$
   $4x + y = -1$
9. $6x = 6y - 1$
   $12y = 24x$
10. $5x - y = -5$
    $5y = 5x + 29$
11. $2y - x = 0$
    $4x + y = 18$
12. $-y = x$
    $30y + 5x = 25$
13. $28y + 5x = 4$
    $7y = 4x + 1$
14. $x + y = 1$
    $x - y = 5$
15. $2x + 3y = -7$
    $3y = x + 5$
16. $6x + y = 6$
    $12x - y = -3$

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Rational and Irrational Numbers

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. the set of rational numbers is a proper subset of the reals.	205	8-10					
. the Pythagorean Theorem.							
The student is able to:							
. determine that $\sqrt{a^2} = \lvert a \rvert$ for any real number a.	207						
. extract the square root of a non-negative real number.							
. identify a rational number as a real number which can be expressed in the form $\frac{a}{b}$, a and b integers, $b \neq 0$.							
. identify irrational numbers as real numbers which cannot be expressed in the form $\frac{a}{b}$, a and b integers, $b \neq 0$.	205						
. simplify radical expressions.							
. solve radical equations.							
. add, subtract, multiply and divide radical expressions.							
The student values:							

Suggested Objective Placement 8 - 10

State Goal	1, 8
District Goal	
Program Goal	6,7,8

Student Learning Objective(s) A. The student knows the set of rational numbers is a proper subset of the reals. B. The student is able to identify a rational number as a real number which can be expressed in the form $\frac{a}{b}$, a and b integers, $b \neq 0$. C. The student is able to identify irrational numbers as real numbers which cannot be expressed in the form $\frac{a}{b}$, a and b integers, $b \neq 0$.

Related Area(s)

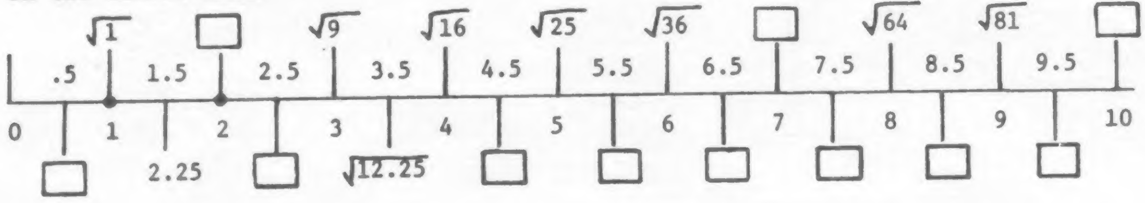
Suggested Activities: Grade(s) 10	Suggested Monitoring Procedures	Possible Resources
Title: Rationals and Irrationals **Group Size:** entire class **Materials:** paper, pencil, worksheet with number line from 0-10 (with $\sqrt{\ }$ modifications) See example below	Teacher observation.	District adopted text.

Procedure(s):

. To help students readily identify placement of irrational and rational numbers, have them complete blank spaces on number line.

Example:

. Students are to fill boxes with the correct number on the number line.



District Resources

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Suggested Activities: Grade(s) ______

Title: Tic Tac Toe
Group Size: pairs
Materials: 3" x 5" index cards with two real numbers to order

Procedure(s):

- Problem cards are placed face down to correspond to the spaces on a Tic Tac Toe game board.
- The players play in turn and choose where they would like to place their "X" or "O."
- Then they attempt to do so by turning over one card at a time, and placing the appropriate sign $>$, $=$, or $<$ between the two real numbers.
- The player who is first to get three answers correct in a row, column, or diagonal is the winner.

- Sample Tic Tac Toe Game Board:

$\frac{4}{3}$ $\sqrt{2}$	π 3	$\frac{7}{8}$ $\frac{5}{6}$
$\sqrt{3}$ 2	$-\frac{5}{9}$ $-\frac{2}{3}$	$\frac{5}{3}$ $\sqrt{3}$
3 $\sqrt{5}$	$\frac{2}{3}$ $\frac{5}{8}$	$\frac{7}{4}$ $\sqrt{4}$

Suggested Monitoring Procedures

Teacher observation

Possible Resources

District adopted text

District Resources ______

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Suggested Objective Placement 8-10

Student Learning Objective(s) The student is able to determine that $\sqrt{a^2} = |a|$ for any real number a.

State Goal	1
District Goal	
Program Goal	6,7,8

Related Area(s)

Suggested Activities: Grade(s) 10	Suggested Monitoring Procedures	Possible Resources

Title: Mind Teaser
Group Size: entire class
Materials: chalkboard or overhead

Procedure(s):

. Before introducing definition $\sqrt{a^2} = |a|$ put this mind teaser on board or overhead.

$4 - 10 = 9 - 15$

Add $\frac{25}{4}$ to both sides.

$4 - 10 + \frac{25}{4} = 9 - 15 + \frac{25}{4}$

$(2 - \frac{5}{2})^2 = (3 - \frac{5}{2})^2$ factor

$\sqrt{(2 - \frac{5}{2})^2} = \sqrt{(3 - \frac{5}{2})^2}$ take square root of both sides

$2 - \frac{5}{2} = 3 - \frac{5}{2}$ add $\frac{5}{2}$ to both sides

$2 = 3$ Why?

(continued on back)

District Resources

Suggested Activities: Grade(s) _______

Suggested Monitoring Procedures

Suggested Resources

$$\sqrt{(2 - \frac{5}{2})^2} = \left|(2 - \frac{5}{2})\right|$$

same with

$$\sqrt{(3 - \frac{5}{2})^2} = \left|(3 - \frac{5}{2})\right|$$

and

$\left|2 - \frac{5}{2}\right|$ does equal $\left|(3 - \frac{5}{2})\right|$

therefore the need for the definition of

$\sqrt{a^2} = |a|$ for any real number a.

District Resources

352

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SUBJECT: MATHEMATICS

SPECIFIC AREA: ELEMENTARY ALGEBRA

Quadratic Expressions

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. the quadratic formula.		8-10					
. how to complete the square.							
The student is able to:							
. solve quadratic equations by using the quadratic formula.							
. solve quadratic equations by completing the square.							
The student values:							

SMALL SCHO PROJECT

Suggested Objective Placement ______

Student Learning Objective(s) ______

Related Area(s) ______

State Goal	☐
District Goal	☐
Program Goal	☐

Suggested Activities: Grade(s) ______	**Suggested Monitoring Procedures**	**Possible Resources**
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		

District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Review of Elementary Topics

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. how to state, recognize, and use the ordered field properties.		10-12					
. how to add, subtract, multiply, divide and raise to a power using real numbers.							
. how to simplify rational algebraic expressions.							
. how to solve single variable equations and inequalities and graph their solution sets.							
. how to add, subtract, multiply, divide and factor polynomials.							
. how to add, subtract, multiply and divide rational algebraic expressions.							
The student is able to:							
The student values:							

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Suggested Objective Placement ________

Student Learning Objective(s) ________

State Goal	☐
District Goal	☐
Program Goal	☐

Related Area(s) ________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Irrational Numbers and Radicals

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. how to identify rational and irrational numbers.		10-12					
. how to simplify radical expressions.							
. how to add, subtract, multiply and divide radical expressions.	219						
. each positive number has two real square roots, zero has one real square root and negative numbers have none.	221						
. each real number has exactly one real cube root.	221						
The student is able to:							
. solve quadratic equations by completing the square and by using the quadratic formula.							
. solve problems in variation.							
. determine the principal n^{th} roots of selected integers.							
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 10-12

Student Learning Objective(s) The student knows how to add, subtract, multiply, and divide radical algebraic expressions.

State Goal	1, 8
District Goal	
Program Goal	2,7,8

Related Area(s)

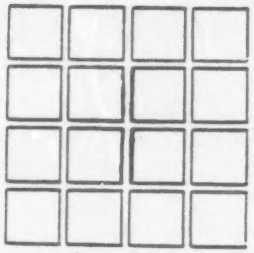
Suggested Activities: Grade(s) 10-11

Title: Concentration Using Algebraic Expressions

Group Size: two students

Materials: concentration gameboard with 16 squares, 16 squares to cover the squares on the gameboard, 8 of one color and 8 of another

CONCENTRATION



Game Board

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Procedure(s):

. Let eight of the cards be algebraic expression cards.

Example:

$5p$	$\frac{p}{5}$	$\frac{x}{2}$	$2x$
$7m$	$\frac{m}{7}$	$\frac{n}{3}$	$3n$

Suggested Monitoring Procedures

Teacher observation.

Possible Resources

District adopted text.

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

- Let eight of the cards be equivalent to other cards.

  Example:

$5-p$	$\frac{4p}{20}$	$\frac{4x}{8}$	$2(x)$
$(7)m$	$\frac{3m}{21}$	$\frac{3n}{9}$	$3.n$

- Place all cards face down on the gameboard so that neither player knows which card is which.
- The first player turns up two cards, one of each color.
- If the player turns up a matching pair, he/she keeps these cards and takes another turn.
- If a matching pair was not turned up, the cards are turned face down in their original position after giving the other player a chance to see them.
- The next player turns up two cards and play continues as before.
- When all the cards have been taken, the player with the most cards is the winner.

District Resources

Suggested Objective Placement 10-12

Student Learning Objective(s) A. The student knows each positive number has two real square roots, zero has one real square root and negative numbers have none. B. The student knows each real number has exactly one real cube root.

State Goal	1,8
District Goal	
Program Goal	2,7,8

Related Area(s) Rational and Irrational Numbers

Suggested Activities: Grade(s) 11-12

Title: Real roots of a number
Size of group: entire class
Materials: Graph paper

Procedure(s):

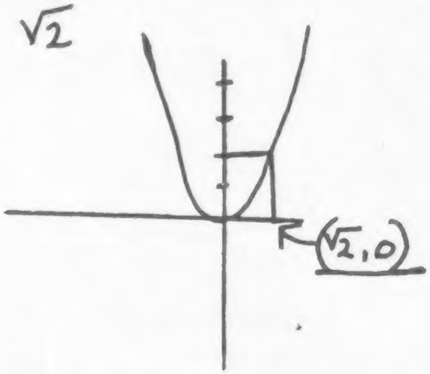
- Very carefully graph the functions

  $y = x^2$ on coordinate paper

  and

  $y = x^3$ on coordinate paper

- To determine the approximate square root (cube root) of a number, find the number (radicand) on the vertical axis. The x coordinate of the ordered pair will be root of the number.
  Example:



Suggested Monitoring Procedures

Have students approximate from their graphs several square roots and several cube roots.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
370		371

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Quadratic Relations and Systems

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. how to determine the distance between two points in a plane.		10-12					
. how to determine the equations of lines in a plane given points and slopes.							
The student is able to:							
. determine equations of lines that are mutually perpendicular or parallel.							
. graph second-degree relations in two variables.							
. identify the conic sections and their distinguishing properties.							
. write the equations for the conic sections.							
. use the system of quadratics to solve problems.							
The student values:							

Suggested Objective Placement ________

Student Learning Objective(s) ____________________

State Goal ☐

District Goal ☐

Program Goal ☐

Related Area(s) ____________________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Suggested Resources

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Exponential and Logarithmic Functions

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
• how to solve equations involving exponents.		10-12					
The student is able to:							
• solve exponential equations, e.g., $5^{4x-1} = 5^{x+5}$.							
• identify inverses of relations.	229						
• convert from exponential to logarithmic form.	229-231						
• use the rules of logarithms, e.g., $\log_b xy = \log_b x + \log_b y$ $\log_b \frac{x}{y} = \log_b x - \log_b y$							
• use tables of logarithms to solve problems.							
The student values:							

Suggested Objective Placement 10-12

Student Learning Objective(s) A. The student is able to identify inverses of relations.

B. The student is able to convert from exponential to logarithmic form.

State Goal	1, 8
District Goal	
Program Goal	2,7,8

Related Area(s) Inverse functions

Suggested Activities: Grade(s) 11-12

Title: Exponential and Logarithmic Functions

Group Size: entire class

Materials: Graph paper

Procedure(s):

- Graph the two functions $y = 2^x$ and $y = \log_2 x$ on one pair of coordinate axis.

  Note the reflections of the functions about the line $y = x$.

  Using the graphs have students approximate $\log_2 3$, $\log_2 5$, $\log_2 6$, $\log_2 2.5$, etc.

Suggested Monitoring Procedures

Answers can be checked on a calculator.

Possible Resources

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 10-12

Student Learning Objective(s) The student is able to convert from exponential to logarithmic form.

State Goal	1,8
District Goal	
Program Goal	2,7,8

Related Area(s) Arithmetic Sequences

Suggested Activities: Grade(s) 11-12

Title: Arithmetic Sequences and Series
Group Size: entire class
Material: paper and pencil

Procedure(s):

- Have students add the natural numbers from 1 to 25.
- Now show them
  1+2+3+4+5+6+7+8+9+...+20+21+22+23+24+25
  - a) Notice 1 + 25 = 26
    2 + 24 = 26
    3 + 23 = 26
  - b) Ask: How many 26's will there be?
    Answer: 12½
    Notice the answer then is $\left(\frac{25}{2}\right)(26) = 325$
- Now have students "add" the natural numbers from 1 to 100. How many 101's are there? What did you get for an answer? 5050
- Other examples: 2 + 5 + 8 +...+29+32+35
  Notice six 37's.
- Etc.
- Now develop formula: $Sn = \frac{M}{2}(A_1 + A_n)$

Suggested Monitoring Procedures

Assign problems from the book for the next day.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Sequence and Series

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. a sequence is an ordered set of numbers.		10-12					
. a series is the sum of the terms of the sequence.	235-236						
. symbols of summation.							
The student is able to:							
. identify arithmetic and geometric sequences.							
. identify a series as a sum of terms in a sequence.	235-236						
. find the n^{th} term and sum of the terms of an arithmetic or geometric series.							
. find the sum of an infinite geometric series.							
. use arithmetic and geometric series to solve problems.							
. use the symbols of summation, e.g., $\sum_{K=1}^{10} (3+2K)$							
The student values:							

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Suggested Objective Placement 10-12

Student Learning Objective(s) A. The student knows a series is the sum of the terms of a sequence. B. The student is able to identify a series as a sum of terms in a sequence. C. The student is able to identify arithmetic and geometric sequences.

State Goal	1,8
District Goal	
Program Goal	2,7,8

Related Area(s)

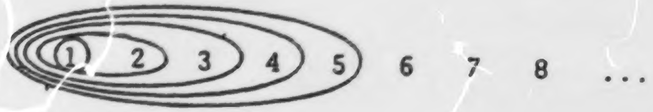
Suggested Activities: Grade(s) 11-12

Title: Forming Sequences from sequences
Group Size: Small groups; entire class
Materials: Paper, chalkboard or overhead

Procedure(s):

- Explain to students that number patterns and numerical sequences are often generated using a functional (formula) approach. Suggest that one alternative is to use some familiar number patterns to generate other number patterns.

Example: Start with a sequence of counting numbers:
1 2 3 4 5 6 7 8 . . .
Circle the first number, then the first two numbers, then the first three, then the first four, etc. and write down the sums of the numbers in each of the circles.



1 3 6 10 15 ...

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387

Suggested Monitoring Procedures

Observation of students number patterns as a quiz.

Possible Resources

Forming Sequences From Sequences
Edward C. Beardslee
Seattle Pacific University

District Resources

388

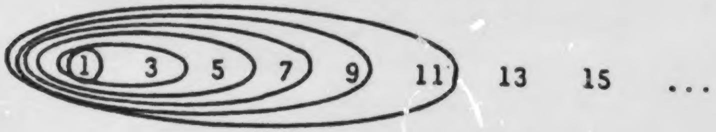
Suggested Activities: Grade(s) 11-12

Ask students if they recognize this sequence as the set of triangular numbers!

Try another example: begin with a sequence of odd numbers.

1 3 5 7 9 11 13 15 . . .

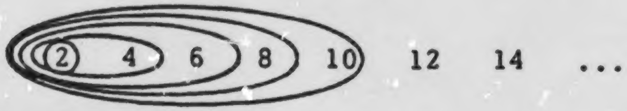
Try the same approach here, circle the first number, then the first two numbers, then the first 3, etc. and write down the resulting sums.



1 4 9 16 25 36 ...

Here the square numbers are obtained.

Now try to develop a sequence using the even numbers.



2 6 12 20 30 ...

Suggested Monitoring Procedures

Possible Resources

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Matrices and Determinants

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
• how to solve two equations in two variables by addition, by graphing, and by substitution.		10-12					
• an array is a rectangular arrangement of numbers.							
• the dimensions of a matrix are indicated by rows and columns.							
The student is able to:							
• solve three equations in three variables by addition, by substitution, and by graphing.	239						
• locate x, y, z intercepts in x, y, z coordinate equations.	239						
• use determinants in solving systems of equations.							
• add and subtract matrices.							
• multiply matrix by scalar.							
• multiply matrices.							
• use matrices to solve two equations in two unknowns.							
The student values:							

301

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Suggested Objective Placement 10-12

Student Learning Objective(s) A. The student is able to solve three equations in three variables by addition, by substitution and by graphing. B. The student is able to locate x,y,z intercepts in x,y,z coordinate equations.

State Goal	1,8
District Goal	
Program Goal	1,7,8

Related Area(s) Functions, Determinants, Matrices

Suggested Activities: Grade(s) 11-12

Title: Simultaneous Equations
Groups Size: entire class
Material: pencil and paper

Procedure(s):

- Proceed from two given points to four (or more if students have had matrix solutions of systems of Linear equations) by giving points.

Example:

1. Find the linear function containing (1,2) and (3,-4)

Solution: $y = mx + b$

$$\begin{cases} 2 = m.1 + b \\ -4 = m.3 + b \end{cases} \qquad y = -3x + 5$$

Example:

2. Find a quadratic function containing (1,-4), (2,1) and (3,10)

Solution: $y = ax^2 + bx + c$

$$\left.\begin{array}{r} -4 + a.1^2 + b.1 + c \\ 1 = a.2^2 + b.2 + c \\ 10 = a.3^2 + b.3 + c \end{array}\right\} \therefore y = 2x^2-x-5$$

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Suggested Monitoring Procedures

Divide class into two or more teams.

Keep score on the board.
2 points correct answer
-1 point incorrect answer

Note:

Don't let one or two students dominate the activity.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

District Resources

394

395

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Polynomial Functions and Complex Numbers

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
• complex numbers are ordered pairs of numbers.		10-12					
• that the symbol "i" has the property such that $i^2 = -1$.							
• the standard form a + bi expresses a complex number.							
• the discriminant of the quadratic equation is symbolized by $b^2 - 4ac$.							
The student is able to:							
• simplify radicals whose radicand is negative.							
• find all complex roots of polynomial functions.							
The student values:							

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Suggested Objective Placement ______

Student Learning Objective(s) ______

Related Area(s) ______

State Goal	
District Goal	
Program Goal	

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

Trigonometry

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the definitions of the six trigonometric functions as they relate to a right triangle.	247	11-12					
. the definition of the radian.							
. relationships of the sides in the 30° - 60° - 90° and 45° - 45° triangles.							
. the laws of sines and cosines.							
. standard position of an angle.							
. the definition of inverse relations.							
The student is able to:							
. use tables of trigonometric functions to solve problems.							
. graph trigonometric functions.							
. prove trigonometric identities.							
. solve trigonometric equations.							
. convert from polar to rectangular coordinates and vice versa.							
. find the missing parts of triangles using trigonometric formulas.							
. convert radian to degree measure and vice versa.							
. graph the inverse trigonometric relation.							
. determine the principal range of the inverse trigonometric relation.							
. use De Moivre's theorem to find powers and roots of a complex number.							
The student values:							

401

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Suggested Objective Placement 10-12

Student Learning Objective(s) The student knows the definitions of the six trigonometric functions as they relate to a right triangle.

State Goal	1
District Goal	
Program Goal	2,6,7

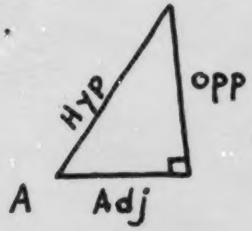
Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: "Oscar's Law"
Group Size: entire class
Materials: pencil and paper

Procedure(s):

- Have students sketch any right triangle and label one acute angle A. Label the sides with respect to $\angle$A.
    Opposite - Opp
    Adjacent - Adj
    Hypotenuse - Hyp
- e.g.,



- Have the students list the three functions in this order and define their side relationships.

$$\text{Sin A} = \frac{\text{Opp}}{\text{Hyp}}$$

$$\text{Cos A} = \frac{\text{Adj}}{\text{Hyp}}$$

$$\text{Tan A} = \frac{\text{Opp}}{\text{Adj}}$$

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Suggested Monitoring Procedures

Teacher Observation

Possible Resources

District text

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

- Have students key on the first letter of each side for Oscar's Law.

$$\text{Sin A} = \frac{\text{Oscar}}{\text{Had}}$$

$$\text{Cos A} = \frac{\text{A}}{\text{Heap}}$$

"Oscar Had A Heap Of Apples"

$$\text{Tan A} = \frac{\text{Of}}{\text{Apples}}$$

District Resources

404

405

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED ALGEBRA

	Page	Suggested Grade Placement	District Placement				
Permutations, Combinations and Probability			8	9	10	11	12
The student knows:							
. definition of a factorial.		10-12					
. a permutation is an arrangement of objects in a definite order.	251						
. a combination is an arrangement of objects without regard to order.							
The student is able to:							
. find the number of permutation of n objects taken r at a time.	251						
. find the number of combinations of a set of n objects taken r at a time.							
. compute probability of a simple event.							
. expand a binomial using the binomial theorem.							
The student values:							

Suggested Objective Placement 10-12

Student Learning Objective(s) A. The student is able to find the number of permutation of n objects taken r at a time. B. The student knows a permutation is an arrangement of objects in a definite order.

State Goal	1
District Goal	
Program Goal	2,6,7

Related Area(s)

Suggested Activities: Grade(s) 11 - 12

Title: Permutation
Group Size: 4 students
Materials: 5 distinct geometric shapes cut out of colored construction paper for each group.

Procedure(s):

- Have students arrange the 5 geometric shapes in as many different ways as possible:

  1) 5 at a time
  2) 4 at a time
  3) 3 at a time
  4) 2 at a time

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Suggested Monitoring Procedures

Teacher Observation

Possible Resources

Probability and Statistics

Summer Workshop 1976
SPI

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

400

410

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

As A Mathematical System

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that a mathematical model is an abstract system devised by people to help understand physical phenomena.		9-11					
. that geometries can be developed solely by rules of logic, independent of physical world appearances.	255- 256						
. that Euclidean and non-Euclidean geometries exist.							
. that mathematically valid deductions are dependent on the assumptions (axioms, or postulates) and will change as the assumptions change.	255- 259						
. inductive reasoning: taking specifics and coming up with a generalization.	255- 256						
. deductive reasoning is reasoning from accepted facts to a conclusion.	257						
. the math system is composed of: undefined terms (e.g., point line plane) defined terms assumptions (e.g., axioms or postulates) theorems							
. the parts of a formal proof (i.e., figure, given, to prove and body of proof).	257- 259						
The student is able to:							
. distinguish between inductive reasoning and deductive reasoning.	255- 256						
. recognize a definition that is good (both concise and precise) and is able to write the ones common to Geometry.	255- 256						
. write formal proofs.	257						
. develop a geometrical argument in either the indirect or direct method of proof.	257						
The student values:							
. analytical and critical thinking as an important tool in today's society.							

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Suggested Objective Placement 9-11

State Goal	1
District Goal	
Program Goal	4,6

Student Learning Objective(s) A. The student knows that geometries can be developed solely by rules of logic, independent of physical world appearances. B. The student knows that mathematically valid deductions are dependent on the assumptions (axioms, or postulates) and will change as the assumptions change. C. The student knows inductive reasoning: taking specifics and coming up with a generalization. D. The student is able to distinguish between inductive reasoning and deductive reasoning. E. The student is able to recognize a definition that is good (both concise and precise) and is able
Related Area(s) to write the ones common to Geometry.

Suggested Activities: Grade(s) 9-10

Title:
Group Size: Individual
Materials: Papers

Procedure(s):

- Have students do paper following proofs related to:
  1) Equalateral Triangles
  2) Limit of Transversals'
  3) Parabola's'
  4) Ellipses
  5) Hyperbolas

Title: Paper Fold Perpendiculars
Group Size: Small group, entire class
Materials: Paper, pencil

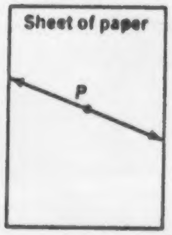
Procedure(s):

- Have students draw any line and locate a point (P) on it. (Step 1)
- Have students fold the paper back along the line. (Step 2)
- Have students fold the paper back along the dotted 1 line at P so that the base edges match. (Step 3)
- Have students unfold the paper. The dotted line is perpendicular to the initial line at P.
- Note that the dotted line is not drawn, it is constructed by folding.

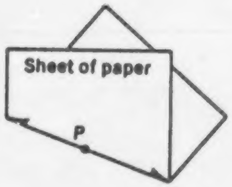
Suggested Monitoring Procedures

Observation
Demonstration

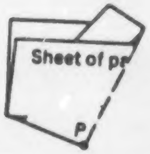
Teacher observation and assistance



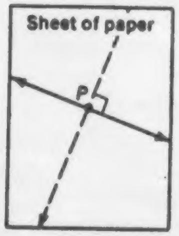
Step 1



Step 2



Step 3



Step 4

Possible Resources

Paper Folding Geometry
Donovan A. Johnson, J. Weston Walch, Portland, Maine 04104
1976

Basic Mathematics, Deans, et al
American Book Co., San Francisco, 1977

District Resources

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Suggested Activities: Grade(s) 9,10

Title: Proofs of Paper Folds for the Mathematician

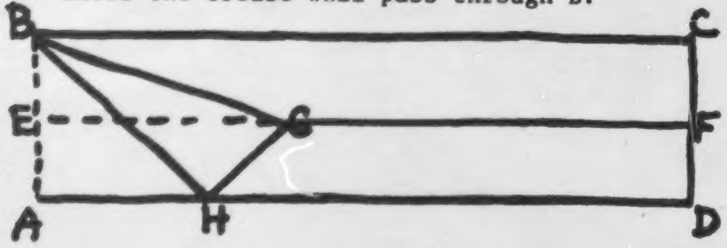
Proving: A certain paper fold forms a 30-60-90° triangle

Assumptions: In paper folding we assume the following postulates:

1. Paper can be folded so that a crease is formed.
2. Paper can be folded so that the crease passes through one or two given points.
3. Paper can be folded so that a point can be superimposed on another point on the same sheet.
4. Paper can be folded so that a straight line can be made to coincide with another straight line on the same sheet when one line is placed upon the other.
5. Line segments and angles are said to be congruent if they coincide when one is superimposed upon another by folding the paper.

Activity:

1. Use a rectangular sheet of paper A B C D
2. Fold the bisection of the short side AB label it EF.
3. Fold the corner A upon EF, slide A along EF until the crease will pass through B.



Proof: That ABH is a 30-60-90° Triangle.

Suggested Monitoring Procedures

1. Lead students through procedure by example.
2. Teacher observation and assistance.

Possible Resources

A Mathematics Laboratory Handbook for Secondary Schools; Stephen Krulik, W.B. Saunders Co., Philadelphia, PA 19105 1972.

Paper Folding Geometry
Donovan A. Johnson, J. Weston Walch, Portland, Maine 04104 1976

District Resources

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows deductive reasoning is reasoning from accepted facts to a conclusion. B. The student knows the parts of a formal proof (i.e., figure, given, to prove and body of proof). C. The student is able to write formal proofs. D. The student is able to develop a geometrical argument in either the indirect or direct method of proof.

State Goal	1
District Goal	
Program Goal	4,6

Related Area(s)

Suggested Activities: Grade(s) 10-11

Title:
Group Size: Individual
Materials: Pencil and paper

Procedure(s):

- If $2x - 1 = 9$, then $x = 5$.

  Given: $2x - 1 = 9$
  Prove: $x = 5$

Proof

1. $2x - 1 = 9$	1. Given
2. $2x = 10$	2. Addition property of equality
3. $x = 5$	3. Division property of equality

- Have students prove a number of Algebraic statements. e.g.,
  1. If $\frac{x}{2} + 3 = -1$, then $x = -8$
  2. If $3x - 2 = x + 1$, then $5x = \frac{15}{2}$
  3. etc.
  4. etc.

Suggested Monitoring Procedures

Teacher observation and assistance

Worksheets of problems

Possible Resources

District text

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
418		419

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the parts of a formal proof (i.e., figure, given, to prove and body of proof). B. The student knows that mathematically valid deductions are dependent on the assumptions (axioms, or postulates) and will change as the assumptions change.

State Goal	1
District Goal	
Program Goal	4,6

Related Area(s)

Suggested Activities: Grade(s) 10

Title: Theorem Blowups
Group Size: Singles
Materials: White construction paper
Different color marker pens
Book

Procedure(s):

- Each student is assigned the task of copying a different theorem. They are then displayed together in order.

Suggested Monitoring Procedures

Monitoring
Written checks

Possible Resources

District adopted text for Geometry

District Resources

420

421

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Congruence and Similarity

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
• similar figures have the same shape.		9-11					
• congruent figures have the same size and shape.	263-265						
• that corresponding parts of congruent figures are congruent.	265						
• that corresponding sides of similar figures are proportional and the corresponding angles are congruent.	263-267						
• the minimum requirements for congruence of triangles (SSS, SAS, ASA).	263						
• the minimum requirements for similarity of plane figures.	265						
• the properties of different kinds of quadrilaterals.							
• the Pythagorean Theorem.	269						
The student is able to:							
• apply the standard Euclidean geometry theorems to prove pairs of triangles congruent; prove corresponding parts of congruent triangles congruent; and prove properties of other polygons, e.g., opposite angles of a parallelogram are congruent.	263-265						
• apply the Pythagorean Theorem and its corollaries in the solution of problems.							
• apply properties of ratio and proportion in the solution of problems.	267						
The student values:							

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows congruent figures have the same size and shape. B. The student knows that corresponding sides of similar figures are proportional and the corresponding angles are congruent. C. The student knows the minimum requirements for congruence of plane figures (SSS,SAS, ASA, HL, HA, LA, LL). D. The student is able to apply the standard Euclidean geometry theorems to prove pairs of triangles congruent; prove corresponding parts of congruent triangles congruent; and prove properties of other polygons, e.g., opposite angles of a parallelogram are congruent.

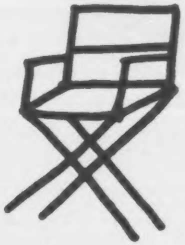
Related Area(s)

State Goal	1,8
District Goal	
Program Goal	1,4

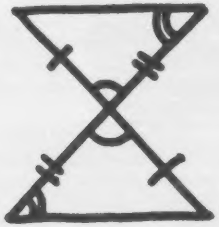
Suggested Activities: Grade(s) 9-10	Suggested Monitoring Procedures	Possible Resources
Title: Director's chair **Group Size:** Individual **Materials:** Director's chair or picture of chair, pencil and paper	Help students set up a formal proof. Observation and guidance.	

Procedure(s):

- Prove that if the legs of a director's chair bisect each other the edge of the chair seat will be parallel to the floor.



- Use corresponding parts of congruent triangles to prove lines parallel.



District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
427		428

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows congruent figures have the same size and shape. B. The student knows that corresponding sides of similar figures are proportional and the corresponding angles are congruent. C. The student knows the minimum requirements for similarity of plane figures. D. The student is able to apply the standard Euclidean geometry theorems to prove pairs of triangles congruent; prove corresponding parts of congruent triangles congruent; and prove properties of other polygons e.g., opposite angles of a parallelogram are congruent.

Related Area(s)

State Goal	1,8
District Goal	
Program Goal	2,4,6

Suggested Activities: Grade(s) 9-10	Suggested Monitoring Procedures	Possible Resources
Title: Research Problem - Congruence **Group Size:** Entire class **Materials:** Paper, straight-edge protractor **Procedure(s):** • Begin the discussion by asking students, "Is it possible for two triangles to have five parts (sides and angles) of one congruent to five parts of the other triangle, but the triangles are not congruent?" • Support your answer with a construction.	Discuss question in class. Guide student through construction.	*Geometry: A Transformational Approach*, Coxford and Usiskin Laidlaw Brothers
		District Resources

429

430

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows that corresponding sides of similar figures are proportional and the corresponding angles are congruent. B. The student is able to apply properties of ratio and proportion in the solution of problems.

State Goal	9-10
District Goal	
Program Goal	6

Related Area(s)

Suggested Activities: Grade(s) 9-12

Title: Similarity Ratios in Photographs
Group Size: Class or individuals
Materials: Negative and its enlarged photograph. Phographes of buildings

Procedure(s):

- Find a photograph of a building in your neighborhood. How can you use the photograph to find the height of the building?
- Compare the negative of a photograph and the enlarged photograph. What is the ratio of lengths? of widths? What is the similarity ratio?

Suggested Monitoring Procedures

Teacher assistance and guidance.

Possible Resources

Geometry: A Transformational Approach, Coxford and Usiskin Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

District Resources

435

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Suggested Objective Placement 9-11

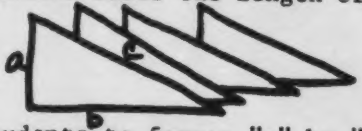
Student Learning Objective(s) The student knows the Pythagorean Theorem.

State Goal	1,4
District Goal	
Program Goal	4,6

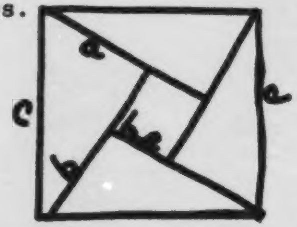
Related Area(s)

Suggested Activities: Grade(s) 10

1. Each student is given four congruent right triangles. Have students label the length of each edge.



2. Ask the students to form a "c" by "c" square using the four triangles.



3. Have them write an expression for the area of the square using "c" alone. Then they must write another expression for the area using "a" and "b."

4. Final Result

$2 \times a \times b + (b-a)^2 = c^2$

i.e., $a^2 + b^2 = c^2$

Suggested Monitoring Procedures

The teacher should allow the students time to work out almost all the steps with minimum help.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
439		440

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Triangle Inequality

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the sum of any two sides of a triangle is greater than the third side.	273	9-11					
. the relation between sides and angles of a given triangle.	275						
. the algebra of inequalities (i.e., addition, subtraction, multiplication, and division; e.g., if $a>b$ and $c<0$, then $ac<bc$)							
The student is able to:							
. find the range of values for the third side of a triangle given two sides.	273-275						
. use inequalities in formal proofs.							
. graph inequality relationships.							
The student values:							

411

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the sum of any two sides of a triangle is greater than the third side. B. The student is able to find the range of values for the third side of a triangle given two sides.

State Goal	1,10
District Goal	
Program Goal	1,4

Related Area(s)

Suggested Activities: Grade(s) 10

Title: Constructing Triangles
Group Size: Individual
Materials: paper and ruler

Procedure(s):

- Measure off 9" and 4" sections 1" wide.
- Measure the third side of a triangle with the smallest possible third side.
- Measure the third side of a triangle with the largest possible third side.

Explain: The range of values for the third side 'a' of a triangle given side x and side y is /x-y/ a x + y

Suggested Monitoring Procedures

Teacher observation and assistance.

Possible Resources

Geometry: A Transformational Approach, Coxford/Usiskin
Laidlaw Brothers

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement ________

Student Learning Objective(s) A. The student knows the relation between sides and angles of a given triangle. B. The student is able to find the range of values for the third side of a triangle given two sides.

State Goal ☐

District Goal ☐

Program Goal ☐

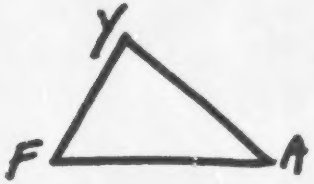
Related Area(s) ________

Suggested Activities: Grade(s) 9-12

Title: Inequalities
Group size: entire class
Materials: protractor - straight edge

Procedure(s):

- Measure the angles and sides of the following triangle and state the relationship between the side opposite the greater angle as compared to the lesser angle.



Suggested Monitoring Procedures

Teacher observation and assistance

Possible Resources

Geometry: A Transformational Approach, Coxford/Usiskine Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY
Angle Relationships/
Parallelism and Perpendicularity

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that an angle is the union of two rays with a common endpoint.		9-11					
. that parallel lines do not intersect and are coplanar.							
. that perpendicular lines form right angles.	279						
. that angles may be classified by size (e.g., acute, right, obtuse, straight).	281						
. definitions pertaining to: angle parallel lines perpendicular lines classification of angles according to size adjacent angles vertical angles complementary angles supplementary angles, corresponding angles, alternate interior angles	279-287						
The student is able to.							
. establish the relationship existing between angles, e.g., supplementary, complementary, vertical, adjacent, interior, linear pairs.	281-286						
. apply the standard Euclidean geometry theorems in order to establish the parallel or perpendicular relationship between lines or planes, e.g., corresponding angles, alternate interior angles.							
. apply the standard Euclidean geometry theorems in order to draw conclusions about angle relationships, given parallel or perpendicular lines, e.g., alternate exterior angles, complementary angles.	278-283						
. determine angle measurements in polygons.	281-283						
. determine angle measurement in problems involving supplementary angles.							
The student values:							
. care and neatness in drawing or constructing figures for the purpose of identifying apparent relationships by measurement.							

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows that perpendicular lines form right angles. B. The student knows definitions pertaining to: angle, parallel lines, perpendicular lines, classification of angles according to size, adjacent angles, vertical angles, complementary angles, supplementary angles, corresponding angles, alternate interior angles. C. The student is able to apply the standard Euclidean geometry theorems in order to draw conclusions about angle relationships, given parallel or perpendicular lines, e.g., alternate exterior angles, complementary angles.

Related Area(s)

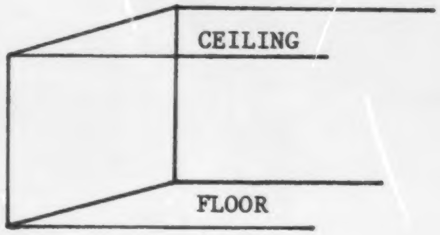
State Goal	1,8
District Goal	
Program Goal	2,4,6

Suggested Activities: Grade(s) 9-10

Title:
Group Size: Individual, whole class
Materials: pencil and paper, regular shaped classroom

Procedure(s):

- Use classroom to show the intersection of two parallel lines e.g., the floor and ceiling as parallel planes and the south wall as the intersecting plane.
  and prove from the illustration that the lines of intersection are parallel.
- Use the classroom to show dihedral angles and polyhedral angles, and the plane angle used in the measurement of a dihedral angle.
- A corner of the room shows three planes intersecting in one point.
- That the student is able to draw the situation:



Suggested Monitoring Procedures

Have a discussion as to the relationships of questions 1-3.

Activity is for the student to draw the situation.

Possible Resources

District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows that angles may be classified by size (e.g., acute, right, obtuse, straight). B. The student is able to establish the relationship existing between angles, e.g., supplementary, complementary, vertical, adjacent, interior, linear pairs.

C. The student is able to determine angle measurements in polygons.

State Goal	1
District Goal	
Program Goal	2,4,6

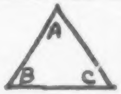
Related Area(s)

Suggested Activities: Grade(s) 10-11

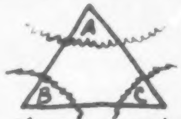
Title: Angle Measurement
Group Size: Individual
Materials: Worksheet with instructions, scissors, paper, pencil, straight edge, protractor

Procedure(s):

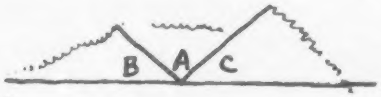
- Draw a large acute triangle and cut it out.
- Label angles "A," "B," "C."



- Tear off angles as follows:



- Place all three vertices together



Questions:

- Do the angles of a triangle fit together to form a straight angle?
- What is the measure of a straight angle?
- What does the activity tell us about the sum of the measures of the interior angles of an acute triangle?
- Repeat activity with an obtuse triangle.
- What does the activity tell us about the sum of the measures of the interior angles of any triangle?
- Measure angles with a protractor as a check for the activity.

Suggested Monitoring Procedures

Have a triangle for yourself and take students through the procedure step by step.

Demonstrate with your own triangle.

Teacher observation.

Lead discussion through questions.

Possible Resources

"A Mathematics Laboratory" Handbook for secondary schools Stephen Krulik, W.B. Saunders Company, Philadelphia, PA 19105, 1972.

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

457

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student is able to establish the relationship existing between angles, e.g., supplementary, complementary, vertical, adjacent, interior, linear pairs. B. The student is able to apply the standard Euclidean geometry theorems in order to draw conclusions about angle relationships, given parallel and/or perpendicular lines, e.g., alternate exterior angles, complementary angles. C. The student is able to determine angle measurements in polygons.

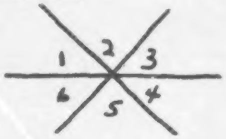
State Goal	1,8
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 10-11

Title: Different Degrees
Group Size: Individual
Materials: Pencil and paper

Procedure(s):



- Suppose the sum of the angles about a point were 260°: i.e., ML 1 + ML 2 + ML 3 + ML 4 + ML 5 + ML 6 = 260°

Questions:

- What is the sum of the angles of a △?
- What is the sum of the angles of a pentagon?
- How large is each angle of a regular pentagon? Each exterior angle?
- etc.

- Suppose the sum of the angles about a point were 1000°

Questions:

- How large is each angle of a regular octagon?
- etc.

Suggested Monitoring Procedures

Lead students through discussion by demonstration.

Worksheet involving above types of angles.

Possible Resources

District Resources

Suggested Activities: Grade(s) _____	Suggested Monitoring Procedures	Possible Resources
		District Resources

401

402

SMALL SCHOOLS PROJECT

Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to establish the relationship existing between angles, e.g., supplementary, complementary, vertical, adjacent, interior, linear pairs.

State Goal 1,4

District Goal

Program Goal 2,4

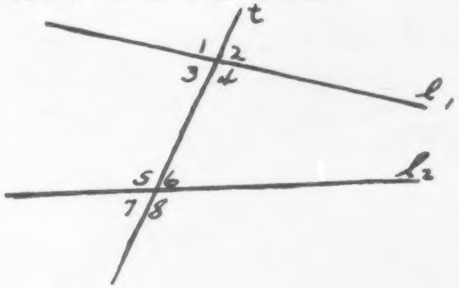
Related Area(s)

Suggested Activities: Grade(s) 9

Title:
Group Size: Individual
Materials: Paper and pencil

Procedure(s):

- A drawing on the chalkboard showing two lines cut by a transversal (3rd line)



Name:

1. 8 pair of supplementary angles
2. 4 pair of congruent angles
3. 2 pair of alternate interior angles
4. 4 pair of corresponding angles
5. 8 pair of adjacent angles
6. 4 pair of vertical angles

(over)

Suggested Monitoring Procedures

Teacher lead discussion.

Worksheet involving identifying above angles in different figures.

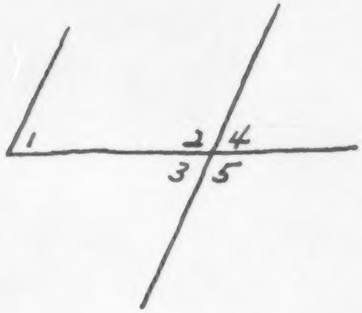
Possible Resources

District Resources

Suggested Activities: Grade(s) ______

Similar drawings:

e.g.,



Questions:

1. How many pair of corresponding angles? Name them.
2. Name all pairs of congruent angles.
3. etc.

Suggested Monitoring Procedures

Suggested Resources

District Resources

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student knows definitions pertaining to: angle, parallel lines, classification of angles according to size, adjacent angles, vertical angles, complementary angles, supplementary angles, corresponding angles, alternate interior angles.

State Goal	1,4
District Goal	
Program Goal	2,4

Related Area(s)

Suggested Activities: Grade(s) 9-10

Title:
Group Size: 8 students
Materials: 2 strips of paper per student

Procedure(s):

- Each student is given 2 strips of paper, each with one of the following on it:
  1. angle
  2. parallel lines
  3. perpendicular lines
  4. acute, obtuse, right, or straight angles
  5. adjacent angles
  6. vertical angles
  7. complementary angles
  8. supplementary angles, corresponding, alternate interior, or dihedral angles
- Each student writes his definition of his topic on the other slip. The group arranges the slips in two columns:

TOPICS

Column I	Column II
1.	A.
2.	B.
3.	C.
4.	D.
5.	E.
6.	F.
7.	G.
8.	H.

STUDENT'S DEFINITIONS ARRANGED RANDOMLY

- Each student will match the topic in Column I to the correct definition in Column II.

Suggested Monitoring Procedures

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY
Retention of Algebraic Skills/
Coordinate Geometry

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that certain mathematical ideas may be represented algebraically or geometrically, e.g., linear equations and their geometric representations.		9-11					
. the formula for mid-point of a line segment.							
. the formula for distance between two points in a plane.							
. the definition of slope.							
. a vertical line has no slope.							
. parallel lines have the same slope.							
. the product of the slopes of two perpendicular lines is negative one.							
The student is able to:							
. graph a linear equation in two variables by (a) slope and y-intercept, (b) both intercepts, (c) point and slope, or (d) a set of points.							
. determine algebraically when two or more lines are perpendicular, parallel, coincide, or intersect.							
. find the equation of a given line.							
. use the methods of coordinate geometry to prove theorems of plane geometry.							
. apply the skills of first year algebra in evaluating expressions, solving equations.							
. apply the mid-point, slope and distance formulas in problem solving.							
The student values:							

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Suggested Objective Placement ________

Student Learning Objective(s) ________ State Goal ☐

________ District Goal ☐

________ Program Goal ☐

Related Area(s) ________

Suggested Activities: Grade(s) ____	Suggested Monitoring Procedures	Suggested Resources
NO ACTIVITIES HAVE BEEN WRITTEN FOR THIS SECTION. REFER TO SECTION ON ALGEBRA.		
		District Resources

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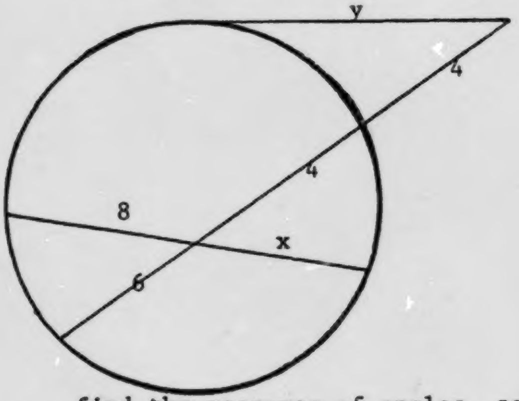
Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Circles, Arcs, Angles, Spheres

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows: . the definitions pertaining to circles and spheres (e.g., circle, sphere, arc, tangent, chord, secant, diameter, radius, central angle, inscribed angle, minor arc, major arc, inscribed, circumscribed).	295-299	9-11					
The student is able to: . apply the relationships in congruence of circles, arc, chords, central angles, inscribed angles, etc., to prove theorems and solve problems, e.g.,  find x: $8x=24$ $x=3$ find y: $\frac{14}{y}=\frac{y}{4}$ $y = 2\sqrt{14}$	295-299						
. find the measures of angles, segments and arcs formed by tangents, chords, and secants of a circle.	297-298						
The student values:							

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the definitions pertaining to circles and spheres (e.g., circle, sphere, arc, tangent, chord, secant, diameter, radius, central angle, inscribed angle, minor arc, major arc, inscribed, circumscribed). B. The student is able to apply the relationships in congruence of circles, arc, chords, central angles, inscribed angles, etc., to prove theorems and solve problems.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s)

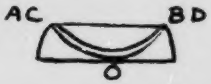
Title: Equal Chords
Group Size: Individual
Materials: Sheet of paper

Procedure(s):

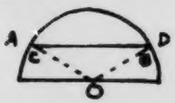
- Draw and cut out a circle. Label the center "O."

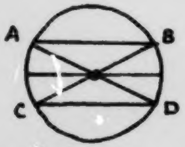
- Fold the circle on itself to form two semicircles. Keep folded.

- Fold the double semicircle to form two chords $\overline{AB}$ and $\overline{CD}$.



- Fold the double semicircle to form the radii $\overline{OB}$ and $\overline{OC}$.





- Why are the chords $\overline{AB}$ and $\overline{CO}$ congruent?
- Why are the arcs AB and CO congruent?
- Are the central angles $\underline{AOB}$ and $\underline{COD}$?
- Fold the bisectors of $\overline{AB}$ and $\overline{CD}$.

(Over)

Suggested Monitoring Procedures

Lead students through folding activity by demonstration.

Teacher observation and assistance.

Possible Resources

Paper Folding Geometry, Donovan A. Johnson, J. Weston Walch Portland, Maine, 1976.

District Resources

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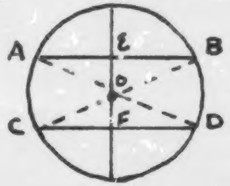
Suggested Activities: Grade(s) ______

- Compare the length of $\overline{EO}$ with $\overline{FO}$ by placing one upon the other.



- Are $\overline{EO}$ and $\overline{FO}$?
- Are equal chords in the same circle the same distance from the center of the circle?

Conclusion:

- What equalities can be stated about the measure of chords, arcs, angles, and distances from the center of a congruent chords of a circle?

Suggested Monitoring Procedures

Possible Resources

District Resources

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the definitions pertaining to circles and spheres (e.g., circle, sphere, arc, tangent, chord, secant, diameter, radius, central angle, inscribed angle, minor arc, major arc, inscribed, circumscribed). B. The student is able to apply the relationships in congruence of circles, arc, chords, central angles, inscribed angles, etc., to prove theorems and solve problems. C. The student is able to find the measures of angles, segments and arcs formed by tangents, chords, and secants of a circle.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s) ______

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

District Resources

Title: Circle Protractor
Group Size: Individual
Materials: Sheet of paper

Inquiry: How can a circle be divided to make a protractor for measuring angles?

Procedure(s):

- Draw and cut out a large paper circle.
- Fold the circle in half by creasing a diameter AB (Figure 1).
- Fold a crease $\overline{CD}$ parallel to the diameter $\overline{AB}$ and half way between the diameter and the circumference (Figure 2).

Open the folds (Figure 3).

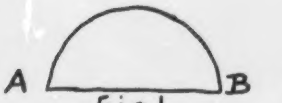


Fig 1

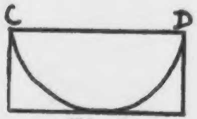


Fig 2

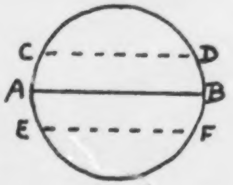


Fig 3

Suggested Activities: Grade(s) _______

- What arcs are congruent?
- Fold A on B to form diameter $\overline{GH}$ perpendicular to $\overline{AB}$ (Figure 4).
- Fold a crease $\overline{IJ}$ parallel to this diameter $\overline{GH}$ and half way between the diameter and circumference (Figure 5). Open the folds (Figure 6).

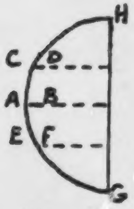


Fig. 4

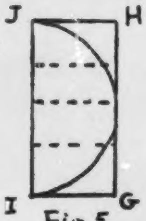


Fig 5

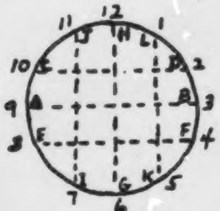
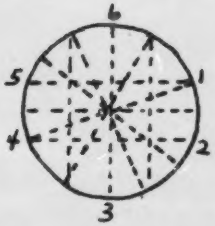
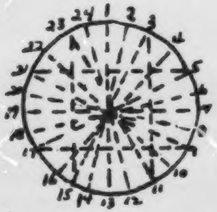


Fig 6

- What arcs are now congruent?
- Fold the radii to these 12 equally spaced points on the circumference (Figure 7).
- Bisect the initial angles to form 12 more equally spaced points (Figure 8).





- How many degrees of arc are measured by one of the 24 equal arcs?
- What fraction of the entire circle is represented by 3 of the 24 congruent sectors?

The circle is now divided into 24 congruent arcs and 24 congruent sectors. This circle can now be used to represent fractions or as a protractor, to measure angles.

483

Suggested Monitoring Procedures

Suggested Resources

District Resources

484

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the definitions pertaining to circles and spheres (e.g., circle, sphere, arc, tangent, chord, secant, diameter, radius, central angle, inscribed angle, minor arc, major arc, inscribed, circumscribed). B. The student is able to apply the relationships in congruence of circles, arc, chords, central angles, inscribed angles, etc., to prove theorems and solve problems.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-12

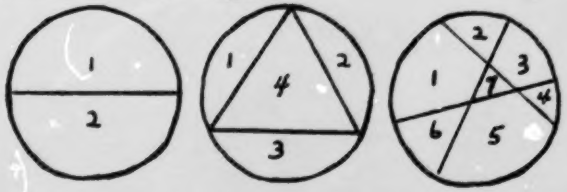
Title: Research Problem - Chords and Circles

Group Size: Class

Materials: Compass, straight edge

Procedure(s):

- Here is a shocker! The problem is concerned with the maximum number of regions that are formed by connecting "n" points on a circle. The figures show that 2 points form 2 regions and 3 points form 4 regions.



- Draw pictures and count the number of regions formed by the chords connecting four points; five points.
- What is your conjecture for the maximum number of regions formed by chords connecting six points on the circle? Test your formula by drawing a picture and counting the regions.

Suggested Monitoring Procedures

Teacher observation and assistance.

Possible Resources

Geometry: A Transformational Approach, Coxford and Usiskin
Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
487		488

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the definitions pertaining to circles and spheres. B. The student is able to apply the relationships in congruence of circles, arc, chords, central angles, inscribed angles, etc., to prove theorems and solve problems.

State Goal 1,10

District Goal

Program Goal 4,6

Related Area(s)

Suggested Activities: Grade(s) 10

Title: Geoboards
Group size: one or two students
Materials: 8" square geoboards, rubber bands

Procedure(s):

- Cut geoboards approximately 8 inches square, place a nail in the center and outline a circle with twenty four nails at equal intervals. (See figure 1)

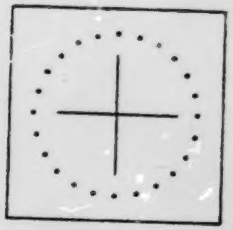


Fig. 1

Geometric shapes can be made by stretching rubber bands from nail to nail.

- Use "thought starters" or questions to initiate investigations.
  Examples: (Directions to students)
  1. Discuss with a partner the degree measure of several central angles. (See figure 2)

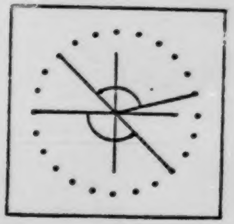


Fig. 2

Suggested Monitoring Procedures

Possible Resources

"Thought Starters for the Circular Geoboard", Jencks & Peck, *Mathematics Teacher*, March, 1974 pp 228-233

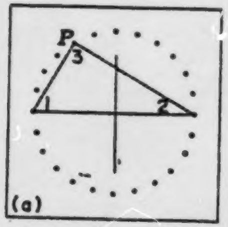
District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Suggested Resources

2. Construct the following central angles and show them to your partner. 45°, 165°, 105°, 60°, 180°, 195°.
3. Find the degree measures of angles 1, 2, & 3 in figure 6a.



4. Discuss the degree measures of angles 1 & 2 in figure 3. Also angles 3 and 4.

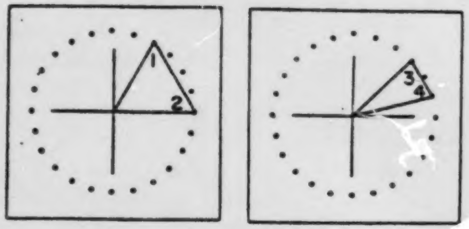


Fig. 3

For a more thorough discussion of ways to use the circular geoboard see the article by Jencks & Peck listed in the resource column.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Constructions and Loci

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
• that a geometric construction is made by using only a compass and a straightedge.	305-307	9-11					
• that a locus of points is the set of all points and only those points which satisfy certain conditions.	305-307						
The student is able to:							
• perform basic Euclidean construction, including: the perpendicular bisector of a segment,	305-311						
an angle bisector,							
the fourth proportional to three given segments,	313						
a triangle, given its three sides,	309						
a rhombus, given a side and one angle,	319						
angle congruent to a given angle,							
line parallel to a given line through a point not in the given line,	315						
line perpendicular to a given line through a point not on the given line,	317 321						
line perpendicular to a given line through a point on the given line,							
proportional division of a segment,							
segment congruent to a given segment,							
tangents to a circle from an exterior point,	323						
construct a segment whose length is the geometric mean of the lengths of the two given segments.	325						
circumscribe a circle around any triangle,							
inscribe a circle in any triangle.							
• find, by construction, the incenter, circumcenter, orthocenter, and centroid of a given triangle.	309						
The student values:							

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Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows a geometric construction is made by using only a compass and a straightedge. B. The student knows that a locus of points is the set of all points and only those points which satisfy certain conditions. C. The student is able to perform basic Euclidean construction.

State Goal	8,10
District Goal	
Program Goal	1,4

Related Area(s)

Suggested Activities: Grade(s) 9-12

Title:
Group Size: Individual, small groups (2-4)
Materials: Compass, straightedge and sticks or straws

Procedure(s):

- Have students discover some of the regular polyhedra by constructing polyhedra from sticks (straws) of the same length.
- Have them prove there could be only 5 regular polyhedra.
- Show there are exactly 5 regular polyhedra by constructing them with sticks and glue. (i.e., tetrahedra, hexahedra, octahedra, dodecahedra and icosahedra).

Suggested Monitoring Procedures

With a little imagination these make very nice Christmas tree ornaments.

Lead students through at least one construction.

Possible Resources

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
496		497

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows that a geometric construction is made by using only a compass and a straightedge. B. The student knows that a locus of points is the set of all points and only those points which satisfy certain conditions.

State Goal 1,10
District Goal
Program Goal 1

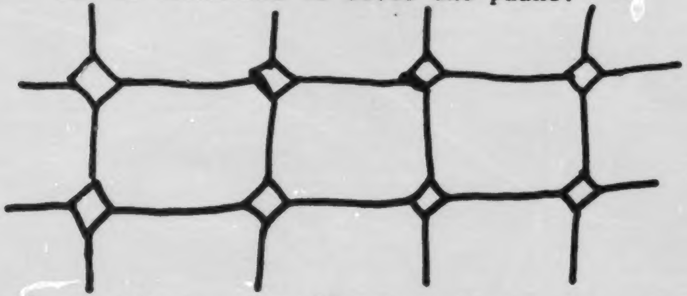
Related Area(s)

Suggested Activities: Grade(s) 9-12

Title: Tessellations
Group Size: Class
Materials: Straightedge, colored pencils, pens.

Procedure(s):

- The Romans decorated their buildings with mosaics made of small tiles called tessellae. The word tessellation is now used to describe ways of filling space. Here are three patterns that can be continued to cover the plane.



- Construct some tessellations of your own. Color them to make attractive designs.
- Investigate which shapes can be used for a tessellation. Will any triangle work? Any quadrilateral? Which regular polygons can be used to form a tessellation?

(Continued over)

Suggested Monitoring Procedures

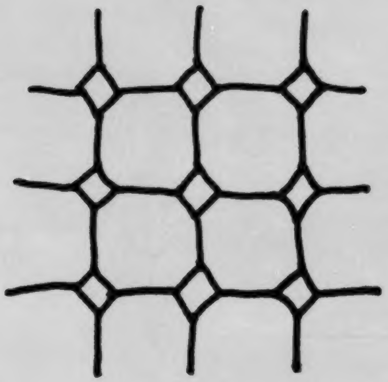
Walking around the room making sure students are constructing proper tessellations.

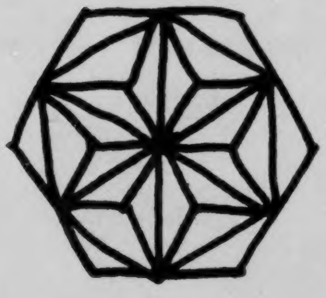
Possible Resources

Geometry: A Transformational Approach, Coxford/Usiskin
Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ______





Suggested Monitoring Procedures

Suggested Resources

District Resources

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student is able to perform basic Euclidean construction, including a triangle, given its three sides. B. The student is able to find, by construction, the incenter, circumcenter, orthocenter, and centroid of a given triangle.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) ______

Title: Ortho Center of the Triangle
Group Size: Individual
Materials: Ruler, scissors

Procedure(s):

- Draw and cut out any scalene, acute triangle ABC.
- Fold the altitudes to each side of the triangle. To fold the altitude from B to $\overline{AC}$, fold the perpendicular to $\overline{AL}$ that passes through B. Label the point of intersection of the first two altitudes D. Label the altitudes $\overline{AE}$, $\overline{BF}$, and $\overline{CG}$.

Questions:

- Do the 3 altitudes intersect in one point?
- Measure the length of the altitudes:
  $\overline{AE}$ = $\overline{BF}$ = $\overline{CG}$ =
- Are the altitudes equal in length?
- Measure the length of these segments:
  $\overline{DE}$ = _____ $\overline{DF}$ = _____ $\overline{DG}$ = _____
- How do the distances from the point of intersection of the altitudes to the base compare with the altitudes?
  $\overline{DE}/\overline{AE}$ = ____ $\overline{DF}/\overline{BF}$ = ____ $\overline{DG}/\overline{CG}$ = ____
- Measure the length of these segments in original figure $\overline{AD}$ = ____ $\overline{BD}$ = ____ $\overline{CD}$ = ____
- How are the measures in #6 related to the measures in #2?
- Where do the altitudes of a triangle meet?
- The intersection point of the altitudes of a triangle is called the Ortho Center of the triangle.
- Variation: See Paper Fold Perpendiculars Activity

Suggested Monitoring Procedures

Teacher observation and assistance.

Check to see students have different types of triangles.

Guide students through questions in a class discussion.

Possible Resources

Paper Folding Geometry, Donovan A. Johnson, J. Weston Walch, Portland, Maine, 1976.

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
504		505

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including an angle bisector.

Related Area(s)

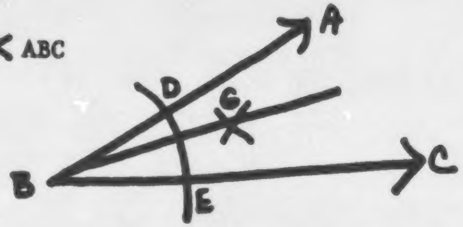
State Goal	1.4
District Goal	
Program Goal	2,4,6

Suggested Activities: Grade(s)

Title: Construction
Group Size: Individual
Materials: Compass and straight edge

Procedure(s):

- Given < ABC



Explanation:

- With center at B and using any convenient radius swing an arc intersecting rays $\overline{BA}$ and $\overline{BC}$. Label the points D and E.
- Choose any radius greater than ½ the distance between D and E. Then from D and E swing arcs that intersect at point G.
- Draw ray $\overline{BG}$.

Suggested Monitoring Procedures

Teacher observation and assistance.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
508		509

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including the fourth proportional to three given segments.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

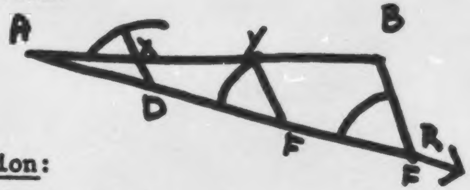
Suggested Activities: Grade(s)

Title: Construction
Group Size: Individual
Materials: Compass and straight edge

Procedure(s):

- Given $\overline{AB}$, construct points X and Y on AB such that $\overline{AX} \cong \overline{XY} \cong \overline{YB}$

Construction:



Explanation:

1. With A as endpoint, draw any ray not colinear with $\overline{AB}$. On the ray, label a point R.
2. Starting with A as center and any convenient radius, construct three congruent segments on $\overline{AR}$. Label the points D, E, and F.
3. Draw FB
4. Construct lines through D and E that are parallel to $\overline{FB}$. Label the points of intersection on $\overline{AB}$ X and Y.

Suggested Monitoring Procedures

Guide students through construction step by step.

Teacher observation and assistance.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

512

513

SMALL SCHOOLS PROJECT

Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including line parallel to a given line through a point not in the given line.

State Goal	1
District Goal	
Program Goal	1,4

Related Area(s)

Suggested Activities: Grade(s) 9-11

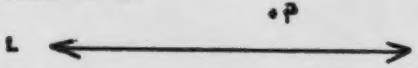
Title:

Group size: individual

Materials: compass and straightedge

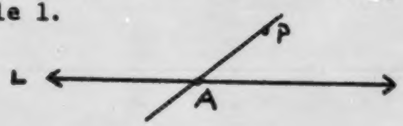
Procedure(s):

Given: Point P not on line L. Construct a line through P parallel to L.



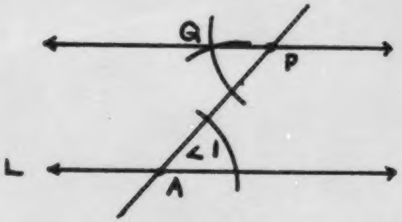
Method:

- Pick any point A on L. Draw a line, AP to determine angle 1.



- Using PA, construct a ray for an angle 2 on the opposite side of PA such an angle 1 $\cong$ angle 2. Label the point where the arcs meet Q.
- Draw PQ, then PQ parallel to L.

Construction:



Suggested Monitoring Procedures

Teacher observation and assistance.

Guide students through construction step by step.

Possible Resources

Geometry, Jurgensen, Donnelly, Maier, Rising, Houghton Mifflin Company, Boston 1978.

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including line perpendicular to a given line through a point on the given line.

State Goal 1,4
District Goal
Program Goal 2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-10

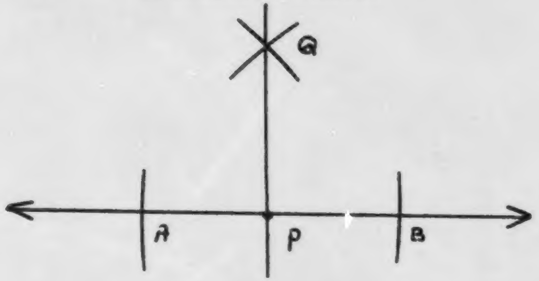
Title: Construction
Group Size: Individual
Materials: Compass, straight edge, pencil, paper

Procedure(s):

- Given P on line m, construct:

  $\overleftrightarrow{PQ} \perp m$

- With P as a center and a convenient radius, construct arcs intersecting m at two points, A and B.
- With A and B as centers and radius greater than AP, construct two arcs intersecting at a point Q.
- Draw the line $\overleftrightarrow{PQ}$. The $\overleftrightarrow{PQ} \perp m$ at P.
- The actual construction shown:



Suggested Monitoring Procedures

Teacher observation and assistance.

Guiding students step by step through construction.

Possible Resources

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including a triangle, given its three sides.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s)

Title: Constructions
Group Size: Individual
Materials: Compass, straightedge, etc.

Procedure(s):

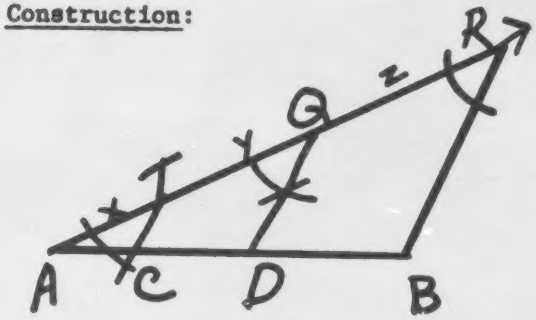
- Given AB, 3 other segments with lengths x, y, and z, construct AC, CD and DB with

$$\frac{AC}{x} = \frac{CD}{y} = \frac{DB}{z}$$

- Choose P not on AB, draw AP.
- On AP, mark off successive lengths, AT = x, TQ = y, and QR = z, draw RB.
- Through T and Q construct lines parallel to RB and cutting AB at C and D, respectively.

Then $\frac{AC}{x} = \frac{CD}{y} = \frac{DB}{z}$

- **Construction:**



Suggested Monitoring Procedures

Monitoring Procedure

1. lead students through constructions step by step.
2. Teacher observation to check students are placing construction marks in the right place.

Possible Resources

Geometry, Jurgensen, Donnelly, Maier, Rising; Houghton Mifflin Company, Boston 1978.

Geometry: A Transformational Approach

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including line perpendicular to a given line through a point on the given line.

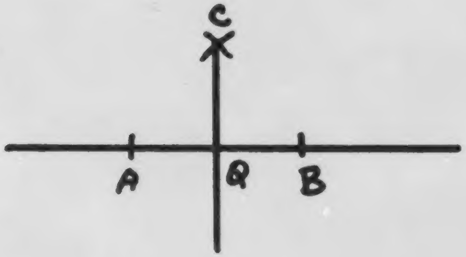
State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s)	Suggested Monitoring Procedures	Possible Resources
Title: Construction **Group Size**: Individual **Materials**: Compass, straight edge	Teacher observation and assistance where needed. Demonstrate step by step so students get construction marks in the right place.	

Procedure(s):

- Given A line and point Q, draw two arcs intersecting the line at A and B with point Q as their center.
- Using A and B draw arcs with the same radius that intersect at point C.
- Draw a line from point C through point Q.



District Resources

526

527

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources
528		529

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including tangents to a circle from an exterior point.

State Goal 1,4
District Goal
Program Goal 2,4,6

Related Area(s)

Suggested Activities: Grade(s)

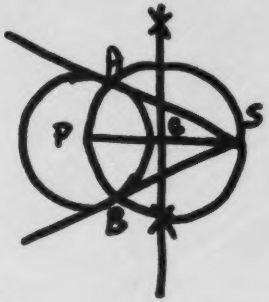
Title: Construction
Group Size: Individual
Materials: Compass, straight edge

Procedure(s):

- Given a circle with center P and a point S in its exterior, construct tangents to the circle from S.

Method:

- Draw $\overline{PS}$. Construct , the perpendicular bisector' of PS. Let Q be the point of intersection of and $\overline{PS}$.
- Using QP as the radius, draw circle Q. Let A and B be the points of intersection of circle Q and circle P.
- Draw $\overline{SA}$ and $\overline{SB}$ which are tangents to circle P from point S.



Suggested Monitoring Procedures

Guide students through construction step by step.

Teacher observation and assistance.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

532

533

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to perform basic Euclidean construction, including constructing a segment whose length is the geometric mean of the lengths of the two given segments.

State Goal	1
District Goal	
Program Goal	2,6

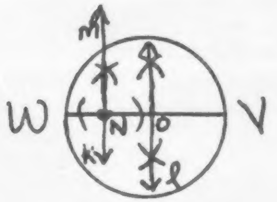
Related Area(s)

Suggested Activities: Grade(s) 9-11

Title: Construction
Group Size: Individual
Materials: Compass, straighedge, paper, etc.

Procedure(s):

- Given AB with AB = x; $\overline{CD}$ with CD = y, construct $\overline{MN}$ such that MN = xy
- Draw $\overline{WV}$ such that WV = x + y. Let N be the point of $\overline{WV}$ such that WN = x.
- Construct the perpendicular bisector of WV. Let O be the point of intersection of and WV using OV as the radius, draw
- Construct a line K, perpendicular to $\overline{WV}$ at N. Let M be a point of intersection of K and . MN = xy
-
- Draw the construction. This is the actual construction:



Suggested Monitoring Procedures

Guide students through construction step by step.

Teacher observation and assistance.

Have students construct one on their own given different lengths.

Possible Resources

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

536

537

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Elementary Transformations

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. that geometric transformations make up one category of mathematical functions.		9-11					
. that congruence is related to transformations called isometries.	329						
. that composites of transformations operate on sets of points in a manner similar to the way in which composites of algebraic functions operate on sets of numbers.							
. that similarity is related to size transformations (contraction or expansion).	331						
The student is able to:							
. find the image of a set of points under a simple reflection (flip).	333						
. find the image of a set of points under a translation (slide).							
. find the image of a set of points under a contraction or expansion.							
. find the image of a set of points under a rotation (turn).							
. identify the center, magnitude, and direction of rotations.	331						
. identify the magnitude and direction of a translation.	331						
. find the pre-image of a point.							
The student values:							

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows that congruence is related to transformations called isometries. B. The student knows that similarity is related to size transformations (contraction or expansion). C. The student is able to find the image of a set of points under a translation (slide).

State Goal	1,4
District Goal	
Program Goal	2,4,6

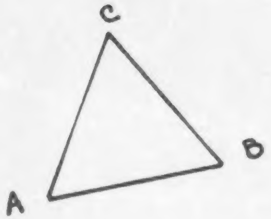
Related Area(s)

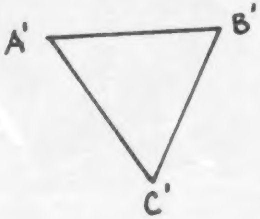
Suggested Activities: Grade(s) 9-10

Title: Transformation
Group Size: Class
Materials: Compass, straight edge

Procedure(s):

. Given $\triangle ABC \cong \triangle A'B'C'$, use a sequance of reflections to map A onto A', B onto B', and C onto C'.





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Suggested Monitoring Procedures

Teacher observations and assistance.

Possible Resources

Geometry: A Transformational Approach
Coxford/Usiskin
Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ____	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows that similarity is related to size transformations (contraction or expansion). B. The student is able to identify the center, magnitude, and direction of rotations. C. The student is able to identify the magnitude and direction of a translation.

State Goal	1,4
District Goal	
Program Goal	2,4,6

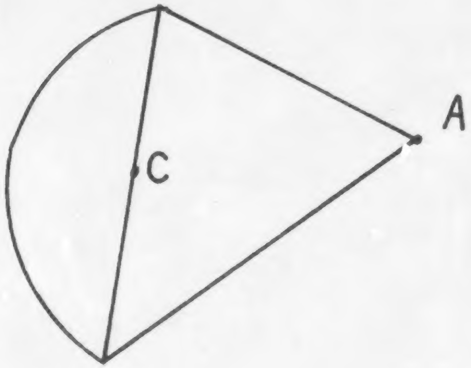
Related Area(s)

Suggested Activities: Grade(s) 9-10

Title: Size Transformation
Group Size: Class
Materials: Compass, straight edge

Procedure(s):

- Trace the figure. Draw the image of this figure under a size transformation with center C, magnitude $\frac{8}{3}$.



Suggested Monitoring Procedures

Teacher observation and assistance.

Possible Resources

Geometry: A Transformational Approach
Coxford/Usiskin
Laidlaw Brothers

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
545		546

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Suggested Objective Placement 9-11

Student Learning Objective(s) The student is able to find the image of a set of points under a simple reflection. (flip)

State Goal 1,4

District Goal

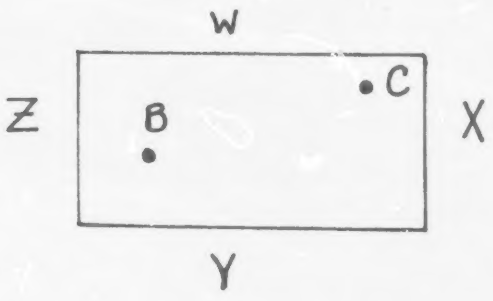
Program Goal 2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-10	Suggested Monitoring Procedures	Possible Resources
Title: Minature Golf **Group Size:** Class **Materials:** Straight edge and Compass	Teacher observation and assistance.	**Geometry: A Transformational Approach** Coxford/Usiskin Laidlaw Brothers

Procedure(s):

- Trace the diagram below. Where would you aim to shoot ball C off side X, then side Y, then side Z and hit ball B?



District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

District Resources

549

550

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Area and Volume

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. how to distinguish between formulas of length, area, and volume.	337-341	9-11					
. the formulas of perimeter and area of triangles, parallelograms, and regular polygons.	339-341						
. the formula for area and circumference of circles.	341-343						
. the formula for surface area and volume of prisms, cylinders, pyramids, cones, and spheres.	337						
The student is able to:							
. use formulas of area and volume in problem solving.	337-353						
The student values:							

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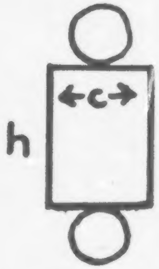
Suggested Objective Placement 9-12

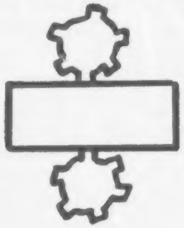
Student Learning Objective(s) A. The student knows how to distinguish between formulas of length, area, and volume. B. The student knows the formula for surface area and volume of prisms, cylinders, pyramids, cones, and spheres. C. The student is able to use formulas of area and volume in problem solving.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-12	Suggested Monitoring Procedures	Possible Resources
Title: Making Models of Cylinders **Group Size:** Class **Materials:** Scissors, construction paper, compass, straight edge	Lead students through step by step. Have class discussion.	**Geometry: A Transformational Approach** Coxford and Usiskin Laidlaw Brothers





Procedure(s):

- To make a model of a cylinder, use a pattern like the one shown. Cut out the pattern and roll the edges of the rectangle together to form the lateral surface. Then fold the bases on. Notice that the length of "c" of the rectangle should be equal to the circumference of the bases. The length of the altitude 'h' can be any convenient length. You could also cut tabs on the bases, as shown, to make it easier to paste the model together.

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

554

555

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Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows how to distinguish between formules of length, area, and volume.B.The student knows the formula for surface area and volume of prisms, cylinders, pyramids, cones, and spheres.

State Goal 1,4

District Goal

Program Goal 2,4,6

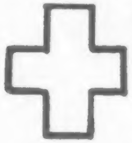
Related Area(s)

Suggested Activities: Grade(s) 9-12

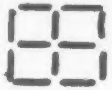
Title: Toothpick Figures
Group Size: Entire class, individual
Materials: 12 toothpicks, ruler

Procedure(s):

- Toothpicks can be used to make geometric figures. The same number of toothpicks can be rearranged to make different figures, as shown:



12 toothpicks
5 square units



12 toothpicks
4 square units

- Use 12 toothpicks to make a square with 5 square units as shown above. By moving just 3 toothpicks, can you make a figure that has an area of 3 square units?
- Use 8 toothpicks to make several different shapes. Find the area of each shape. What figure formed from the 8 toothpicks has the greatest possible area?

Suggested Monitoring Procedures

Teacher observation during activity.

Possible Resources

Geometry: A Model of the Universe
Alan B. Hoffer, Addison-Wesley Pub. Co.

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

558

559

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows how to distinguish between formulas of length, area, and volume. B. The student knows the formulas of perimeter and area of triangles, parallelograms, and regular polygons. C. The student knows the formula for area and circumference of circles.

D. The student is able to use formulas of area dn volume in problem solving.

State Goal	1,4
District Goal	
Program Goal	2,4

Related Area(s)

Suggested Activities: Grade(s) 9-12

Title: Discovery of Pi
Group Size: Individual
Materials: Reproduced circles, rulers, string (able to break with hands)

Procedure(s):

* Review radius and diameter.

- Lay string on outside of circle (circumference) and measure in a straight line with a ruler.
- Measure the diameter.
- Divide the outside of circle distance by diameter.
- Check other circles to determine if resulting number B is constant.
- Write a formula for circumference of a circle.

560

(over)

Suggested Monitoring Procedures

Guide students through procedure step by step.

Possible Resources

District Resources

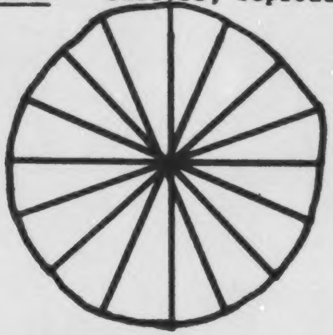
561

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

Title: Discovery of Area Formula For Circle
Group Size: Individual
Materials: Sissors, reproduced circle

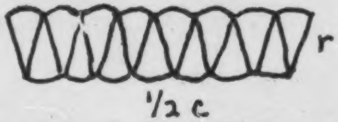


As many equal divisions as possible

Procedure(s):

Review radius, circumference, area of parallelogram

- Cut up circle on lines.
- Piece together as "parallelogram"



- EXPLAIN = area of above figure approximately

  $(\frac{1}{2}c)(r)$ - the base times the height

  $\frac{1}{2}c = \frac{1}{2}(2\pi r) = \pi r$

Thus area of figure πr times r or πr^2

District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-11

Student Learning Objective(s) A. The student knows the formulas of perimeter and area of triangles, parrallelograms, and regular polygons. B. The student knows the formula for area and circumference of circles. C. The student is able to use formulas of area and volume in problem solving.

State Goal	1,10
District Goal	
Program Goal	4,6

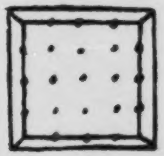
Related Area(s)

Suggested Activities: Grade(s) 10

Title: Geoboards
Group size: individual, pairs
Materials: geoboards, rubber bands

Procedure(s):

- Use geoboards to help students discover a variety of ways to find the area of a given figure. For example: ask the students to make this figure on the geoboard:



Then ask:

- What is the area of this figure?
- Can you make a figure on the geoboard that has an area greater than 16 units.

See the following pages for additional ideas using geoboard.

Suggested Monitoring Procedures

Suggested Resources

Geoboard Handout from Summer Workshop on Math 1976.
Directed by Eldon Egbers
State Supt. of Public Instruction Office
Olympia, Wash.

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

GEOBOARDS

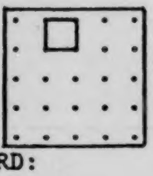
Discovering Ways to Find Area of a Geoboard Figure

Material: Geoboard (5 nail by 5 nail)
Rubber bands

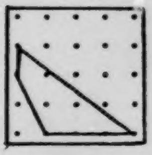
Procedure:

STEP 1: CLEAR YOUR GEOBOARD.

THIS IS ONE UNIT OF AREA:



MAKE THIS SHAPE ON YOUR GEOBOARD:



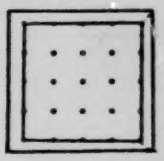
WHAT IS THE AREA OF THIS FIGURE?

Call on several different students to tell the area of the figure and show the class how they know that is the area. Encourage the students to discover a variety of ways to find the area of a given figure.

A method for finding area on the geoboard is only helpful if the student is able to apply, use, and understand it. Therefore, it is not helpful to impose our methods on students. It may be helpful to guide the students' approach in finding a number of different ways to find the area of a figure.

STEP 2: CLEAR YOUR GEOBOARD.

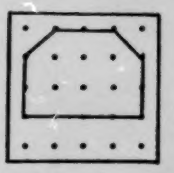
SAY: MAKE THIS FIGURE ON YOUR GEOBOARD:



WHAT IS THE AREA OF THIS FIGURE?

CAN YOU MAKE A FIGURE ON YOUR GEOBOARD THAT HAS AN AREA GREATER THAN 16 UNITS?

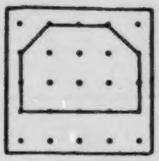
STEP 3: MAKE THIS FIGURE ON YOUR GEOBOARD:



IF 16 UNITS OF AREA IS THE TOTAL AREA ON A 5 X 5 GEOBOARD, WHAT IS THE AREA OF THIS FIGURE?

STEP 3 (cont'd): HOW MUCH AREA ON THE GEOBOARD IS NOT COVERED BY THE FIGURE? or HOW MUCH AREA IS OUTSIDE THE FIGURE ON THE GEOBOARD?

WHAT IS THE DIFFERENCE BETWEEN A TOTAL AREA ON A GEOBOARD AND THE AREA NOT COVERED BY THIS FIGURE?



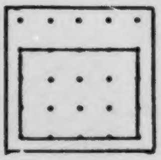
Five units of area outside.

Area inside is 11 units because I can only have 16 units of area on the geoboard.

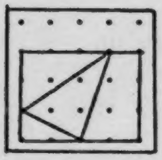
STEP 4: CLEAR YOUR GEOBOARD.

MAKE A RECTANGLE ON YOUR BOARD.

WHAT IS THE AREA OF YOUR RECTANGLE?

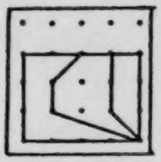


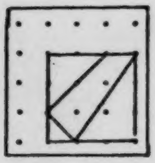
NOW PUT THIS FIGURE INSIDE THE RECTANGLE ON YOUR GEOBOARD:

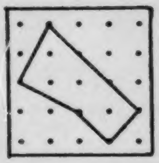


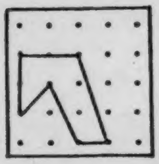
WHAT IS THE AREA OF THE FIGURE INSIDE THE RECTANGLE?

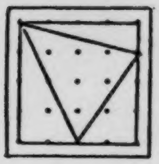
STEP 5: Repeat step 4 using the following figures and rectangles:

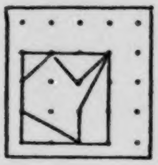


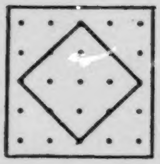


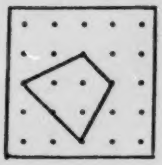












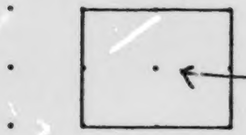
STEP 6: Have the students put figures on the geoboard and then find the area.

STEP 7: Discuss how to find the area of figures with the students. Here are some questions that may be helpful:

(a) Is it helpful to make a rectangle over your figure?
(b) If you can count the area outside a figure, does it help you determine the area of a figure?

What is the largest area you can enclose with 3 nails? With 4 nails? With 5 nails? With 6 nails? Etc. ...

Nails on the inside are not allowed for this question.



nail on the inside
(this is not allowed for this question)

Guide students to organize their information.

Nails touched by rubber band	Area
3	1/2
4	
5	
6	

What is the largest area you can enclose with 100 nails and no nails in the interior?

Can you find a rule to figure the area when given the number of nails?

New Game . . . . New Rules!

If you allow one nail in the interior, can you predict the area?

New Game . . . . New Rules!

If you allow two nails in the interior, can you predict the area?

Suggested Objective Placement 9-12

Student Learning Objective(s) A. The student knows the formula for area and circumference of circles. B. The student is able to use formulas of area and volume in problem solving.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-12

Title: Measuring Wheel
Group Size: entire class
Materials: three inch plastic lids attached to one foot piece of lath at center of lid, i.e.,

Procedure(s):

- Have the students place a mark on the edge of the lid.
- Have students carefully roll the lid one revolution and measure the distance covered. (This should equal the circumference of the lid).
- Have the students divide this distance by three (diameter of lid). The answer should come out 3.1 or very close to it which is the approximate value of π.
- Have the students reverse the operation. (Students will find $\pi \cdot d = C$).

Variation

- For variety or extension of the activity, use a 26" bicycle tire attached to a bike fork, compute circumference of the tire in classroom, then have the students use tire as measuring wheel to measure the school parking lot, football field, etc.

Suggested Monitoring Procedures

Worksheet of problems with the student given the circumference of a circle and asked to find the radius; asked to find the diameter.

Possible Resources

District adopted text.

District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to use formulas of area and volume in problem solving.

State Goal	1,4
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 9-12

Title:
Group Size: Individual, small groups
Materials: Paper, pencil, rulers

Procedure(s):

- Measure the classroom; length, width, and height.
- Given a stack of 100 $1.00 bills. Each bill is 1 inch high (2.5 cm) and 2 inches wide by 5 inches long.
- Determine the amount of money that could be "crammed" into the classroom in denominations of one dollar bills.

Suggested Monitoring Procedures

There is (will be) only one correct answer.

The problem should give the student a feeling also for how much is a million? a billion?

Teacher guidance and assistance.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

577

578

Suggested Objective Placement 9-12

Student Learning Objective(s) The student is able to use formulas of area and volume in problem solving.

State Goal 1,4

District Goal

Program Goal 2,4,6

Related Area(s)

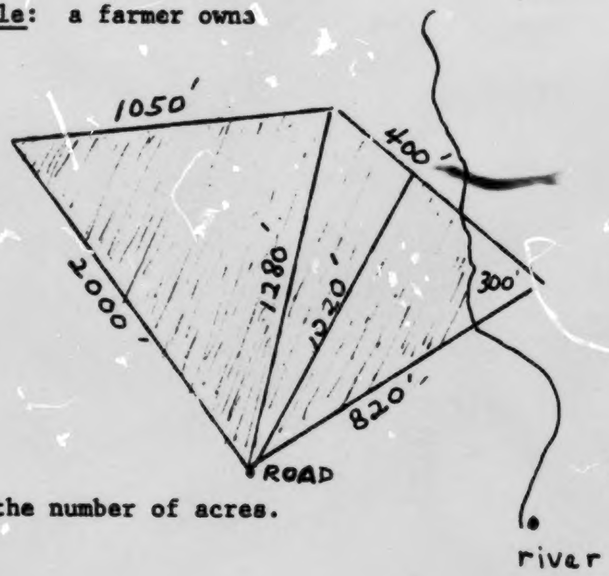
Suggested Activities: Grade(s) 9-12

Title:
Group Size:
Materials:

Procedure(s):

- Draw (or find in the school yard) an irregular shaped polygon to find the area of

Example: a farmer owns



- Find the number of acres.

Suggested Monitoring Procedures

There are different ways to divide the polygon up into triangles - but there is only one correct answer for the area.

Make sure each students' method is a valid procedure.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

581

582

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GEOMETRY

Trigonometry

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
• the relationship between right triangle trigonometry and similarity in geometry.		9-11					
• definitions of sine, cosine and tangent ratios.							
• side length ratios in 30° right angle and 45° right triangle.	357-359						
The student is able to:							
• find the value of the sine, cosine and tangent of a labeled angle in a right triangle, given lengths of its sides.							
• use a table of trigonometric values in order to find the sine, cosine, and tangent of given angles.							
• find the lengths of two sides of a right triangle, given the third side and one acute angle.							
• find the measure of an acute angle of a right triangle, given the lengths of two of its sides.							
• solve word problems requiring the writing and solving of a trigonometric equation.							
The student values:							

SMALL SCHOOLS PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student knows side length ratios in 30° right angle and 45° right triangle.

State Goal	1,4
District Goal	
Program Goal	2,4,6

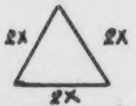
Related Area(s)

Suggested Activities: Grade(s) 9-12

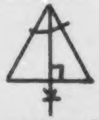
Title: Trigonometry
Group Size: Individual
Materials: Straight edge, compass, pencil

Procedure(s):

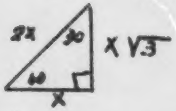
- Construct an equalateral triangle.



- Construct a perpendicular bisector of one angle.

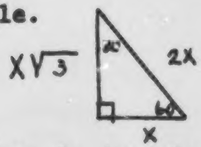


- Now explore the relationship between the sides of the triangle and the ⊥ bisector.
- Solve for missing side using pythagoream theorem.

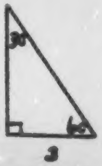


$a^2 = (2x)^2 - x^2$
$a^2 = 4x^2 - x^2$
$a^2 = 3x^2$
$a = \sqrt{3x^2}$ $a = x\sqrt{3}$

- You now have the special triangle formula for a 30°-60°-90° triangle.



- Apply the triangle formula in solving for missing sides.



Other sides are
$3\sqrt{3}$, 6

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Suggested Monitoring Procedures

Lead students through procedure step by step.

Teacher assistance.

Possible Resources

Can be used as construction goals as well as Trig goals.

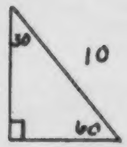
Most district adopted Geometry texts.

District Resources

Suggested Activities: Grade(s) ______

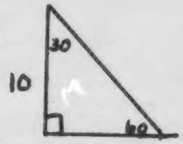
Suggested Monitoring Procedures

Possible Resources



Other sides are

$5, 5\sqrt{3}$



Other sides are

$\frac{10\sqrt{3}}{3}, \frac{20\sqrt{3}}{3}$

District Resources

SMALL SCHOOL PROJECT - Working Copy

Suggested Objective Placement 9-12

Student Learning Objective(s) The student knows side length ratios in 30° right angle and 45° right triangle.

State Goal	1.4
District Goal	
Program Goal	2,4,6

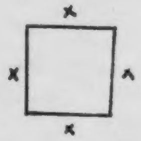
Related Area(s)

Suggested Activities: Grade(s) 9-12

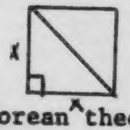
Title: Trigonometry
Group Size: Individual
Materials: Paper, pencil, straight edge

Procedure(s):

- Construct a square



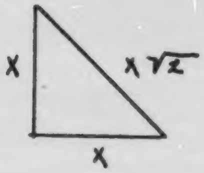
- Draw a diagonal



- Apply the pythagorean theorem to find the length of the diagonal in relation to the length of the side.

$$C^2 = x^2 + x^2$$
$$C^2 = 2x^2$$
$$C = \sqrt{2x^2}$$
$$C = x\sqrt{2}$$

- You now have the special triangle formula for a 45°-45°-90° triangle.



588

(over)

Suggested Monitoring Procedures

Lead students through step by step.

Teacher assistance.

Possible Resources

Can be used as construction goals as well as Trig. goals.

Most Geometry adopted texts.

District Resources

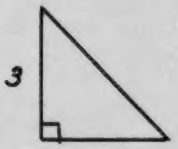
589

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

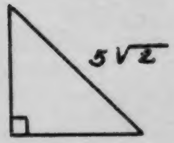
Possible Resources

- Apply the special triangle in solving for missing lengths, (e.g., solve for missing sides).



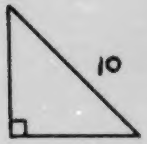
other sides are

3, $3\sqrt{3}$



other sides are

5, 5



other sides are

$5\sqrt{2}$, $5\sqrt{2}$

District Resources

SMALL SCHOOLS PROJECT SUBJECT: MATHEMATICS SPECIFIC AREA: ADVANCED TOPICS Trigonometry	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows: . the definitions of the six trigonometric functions. . the different systems of angle measurement. . De Moivre's theorem is used to find powers and roots of complex numbers in polar form. . the six functional values of the special angles and their multiples, i.e., 0°, 30°, 45°, 60°, 90°, etc. . See Trigonometry for Geometry and Advanced Algebra.		11-12					
The student is able to: . convert from one system of angle measurement to another (radians, degrees). . define and illustrate a directed angle on a circle and in the rectangular coordinate system. . derive and verify identities involving reciprocal, quotient, Pythagorean, sum and difference, and double angle relations and formulas. 1 solve equations and inequalities involving circular and trigonometric functions. . apply the law of sines and law of cosines to solutions of triangles. . solve equations and inequalities involving inverse circular and trigonometric functions. . perform the basic operations, find powers and roots of complex numbers in both standard and polar forms. . find the areas of a triangle by using different formulas, e.g. $A = \frac{ab \sin C}{2}$, $A = \frac{1}{2}bh$, $A = \sqrt{s(s-a)(s-b)(s-c)}$. . use the calculator to solve problems involving the six trigonometric or circular functions. . sketch graphs of the six trigonometric functions and their inverses, giving the domain and range of each. . determine the amplitude, period and phase shift and range of the function $Y = Y_1 + AT(BX+C)$ where T is one of the trigonometric functions and Y_1 is some constant value.							
The student values:							

Suggested Objective Placement ________

Student Learning Objective(s) ________________

State Goal ☐

District Goal ☐

Program Goal ☐

Related Area(s) ________________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Analytic Geometry

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
• the slope of a line is the ratio of change in y to the change in x: $m = \frac{y_1 - y_2}{x_1 - x_2}$		11-12					
• definition of eccentricity.							
• that the graph of a quadratic equation of the form $x^2 + y^2 + Dx + Ey + F = 0$ is a circle.							
• definition of conics involving locus of points.	367						
• that the graph of $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$ is a conic section (ellipse, parabola, hyperbola, circle, line).							
• see Graphs - Functions and Relations Elementary Algebra.							
The student is able to:							
• find the distance between two points.							
• determine an equation of a line given: 2 points or 1 point and a slope.							
• determine if two lines are parallel.							
• determine if two lines are perpendicular.							
• use the methods of analytic geometry to prove theorems of plane geometry.							
• identify a conic section, given its equation.							
• analyze and graph the equation of a conic section.							
• find the equation and sketch conic sections, given particular characteristics, e.g., foci, directrix, vertices, asymptotes.							
• graph and interpret data in both rectangular and polar form.							
• convert rectangular coordinates to polar coordinates and conversely.							
The student values:							

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Suggested Objective Placement 11-12

Student Learning Objective(s) The student knows definition of conics involving locus of points.

State Goal 1

District Goal

Program Goal 2,4,6

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Parabola and Ellipse Construction

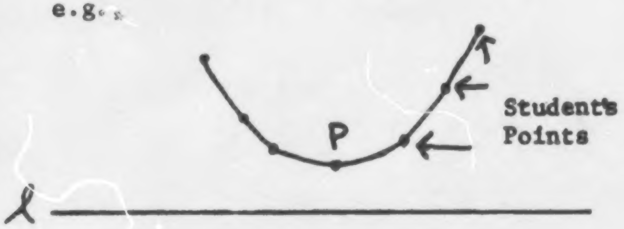
Group Size: entire class for #1
2 students for #2

Materials: paper, pencil, string, and 2 tacks

Procedure(s):

. Given a line l, and any point p not on l, have the student position many points that are equidistant from p and l. Connect the points consecutively.

e.g.,



598
(See other side)

Suggested Monitoring Procedures

Teacher observation

Possible Resources

District Textbook

District Resources

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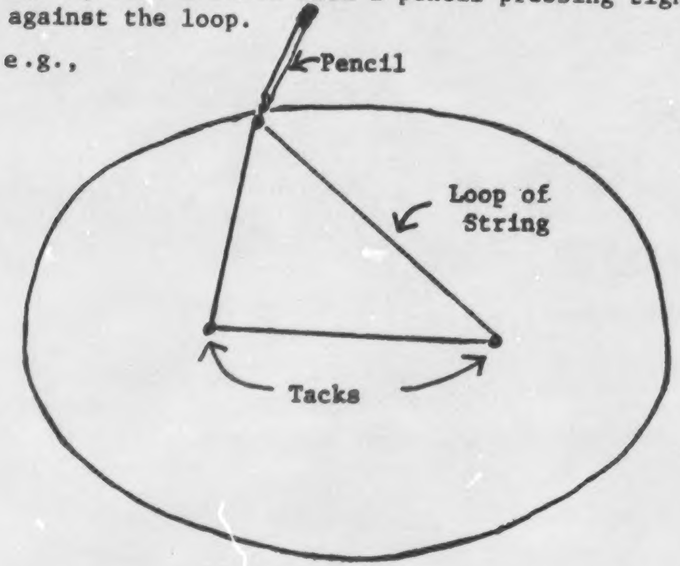
Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

- With a continuous loop of string, about 20 inches long, wrapped around 2 tacks, about 8 inches apart, draw a curve with a pencil pressing tight against the loop.

e.g.,



- Have students define their drawing as an Ellipse and compare their activity with the definition of an Ellipse.

District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Logic

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. the truth values of conditionals, converses, inverses, contrapositives, conjunctions, disjunctions, negations.		11-12					
The student is able to:							
. recognize the hypothesis and conclusion of a conditional statement.							
. use the contrapositive of a statement to prove the statement.							
. form the converse of a given statement.							
. use truth tables to analyze and prove the relationships of statements, e.g., biconditionals, tautologies.							
. form the negation of given statements.							
. analyze a syllogism's truth or falseness.							
The student values:							

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Suggested Objective Placement ____________

Student Learning Objective(s) ______________________________

State Goal	
District Goal	
Program Goal	

Related Area(s) ______________________________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Probability and Statistics

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that permutations and combinations are useful for arranging data to compute probabilities of events.		11-12					
. the meaning of symbols and terms associated with combinatorial mathematics (e.g., factorial, ${}_{n}C_{r}$, ${}_{n}P_{r}$).							
. the relationships between the coefficients in the binomial expansion and Pascal's triangle.							
. the summation definition for the binomial theorem: $(a + b)^n = \sum_{k=o}^{n} \binom{n}{k} a^{n-k} b^k$							
. common measures of variability of data, e.g., range, standard deviation, variance, quartiles, stanines, percentiles.							
The student is able to:							
. calculate the number of combinations or permutations for a stated condition.							
. expand a binomial expression to a positive integral power using the binomial theorem.							
. find the n^{th} term of a binomial expansion.							
. compute the probability of outcomes of ordinary uncertain events (e.g., tossing coin, rolling dice).	375						
. compute the probability of mutually exclusive or independent events.							
The student values:							

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Suggested Objective Placement 11-12

Student Learning Objective(s) The student is able to compute the probability of outcome of ordinary uncertain events (e.g., tossing coin, rolling dice).

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

Suggested Activities: Grade(s) 11-12

Title: Dice Probability
Group Size: 3 students
Materials: Pairs of dice - one red and the other white.

Procedure(s):

- Have the students roll a pair of dice 36 times and record their results. Compare results with:

		1	2	3	4	5	6	Red
White	1	2	3	4	5	6	7	
	2	3	4	5	6	7	8	
	3	4	5	6	7	8	9	
	4	5	6	7	8	9	10	
	5	6	7	8	9	10	11	
	6	7	8	9	10	11	12	

e.g., Dice roll results in Red 3, White 2. Student crosses out 5 in the following position:

		1	2	3	4	5	6	Red
White	1	2	3	4	5	6	7	
	2	3	4	~~5~~	6	7	8	
	3	4	5	6	7	8	9	
	4	5	6	7	8	9	10	
	5	6	7	8	9	10	11	
	6	7	8	9	10	11	12	

Suggested Monitoring Procedures

Teacher observation

Possible Resources

Probability and Statistics

Summer Workshop 1976
Washington State Superintendent
of Public Instruction

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Matrices and Determinants

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that a matrix is a rectangular array of numerals.		11-12					
. conditions which must be satisfied for matrices to be added or multiplied.							
. that the determinant associated with each square matrix is a number (scalar).							
. definition of the inverse of a matrix.							
. see Matrices and Determinants - Advanced Algebra							
The student is able to:							
. add, subtract, and multiply conformable matrices.							
. determine if a square matrix has an inverse.							
. find the multiplicative inverse of a nonsingular square matrix.							
. solve matrix equations.							
. compute the determinant of a square matrix.							
. represent a system of equations with a matrix.							
. use Cramer's Rule to solve systems of equations.							
. solve a system of linear equations by using matrices.							
The student values:							

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Suggested Objective Placement ______

Student Learning Objective(s) ______ State Goal ☐

______ District Goal ☐

______ Program Goal ☐

Related Area(s) ______

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Sequences and Series (Extended)

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. that a series is the indicated sum of a sequence.		11-12					
. that if S is the set of natural numbers and if $1 \in S$, and $X + 1 \in S$, whenever $x \in S$. then S contains all the natural numbers. (Principle of Mathematical Induction)							
. see sequences and series for advanced algebra.							
The student is able to:							
. find the limit of a sequence if it exists.							
. determine whether a given sequence is convergent or divergent.							
. prove theorems by using mathematical induction.							
. write the sum of a series by using summation notation (Σ)							
. see sequences and series for advanced algebra.							
The student values:							

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Suggested Objective Placement ______

Student Learning Objective(s) ______ State Goal ☐

______ District Goal ☐

______ Program Goal ☐

Related Area(s) ______

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources

District Resources

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SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Polynomial Functions

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. that if P(x) ÷ (x-r), then P(r) is the remainder (Remainder Theorem).		11-12					
. that if P(r) = 0, then x-r is a factor of P(x) (Factor Theorem).							
. the Fundamental Theorem of Algebra.							
. that, if P(x) is a polynomial in x and if P(a)=0, then a is a zero of the polynomial and x-a is a factor.							
The student is able to:							
. apply the Remainder Theorem to evaluate a polynomial for any real number.							
. apply the Factor Theorem to find factors of a polynomial.							
. use synthetic division to find the quotient and remainder when P(x) is divided by (x-r).							
. apply the Rational Roots Theorem.							
. use Descartes' Rule of Signs to determine the bounds on the number of positive, negative and total possible roots.							
The student values:							

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Suggested Objective Placement ______

Student Learning Objective(s) ______ State Goal ☐

______ District Goal ☐

______ Program Goal ☐

Related Area(s) ______

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Vector Theory

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. that vectors are directed line segments used to represent quantities having magnitude and direction.	391-393	11-12					
. the symbols common to vectors, e.g., scalar (a), vector ($\vec{c}$), dot product (·).							
. that any two or three dimensional vector can be represented respectively as an ordered pair or triple of real numbers (a,b) or (a,b,c).							
. the definition of displacement of a vector.	391-393						
. the definition of cross product.							
. the vector product (cross product) can be calculated using determinants.							
The student is able to:							
. find the norm (magnitude) and direction of a vector with respect to a coordinate axis.							
. determine if vectors are equivalent.							
. add and subtract vectors, both graphically and algebraically.							
. determine the resultant of a system of vectors both graphically and algebraically.	391-393						
. find the direction cosines of a given vector.							
. find the inner (dot) product of two vectors.							
. use inner (dot) product to determine if vectors are perpendicular or parallel.							
. write equations of lines and segments in vector form and parametric form.							
. rename a vector with either polar or rectangular coordinates.							
The student values:							

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that vectors are directed line segments used to represent quantities having magnitude and direction. B. The student knows the definition of displacement of a vector. C. The student is able to determine the resultant of a system of vectors both graphically and algebraically.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s) ______

Suggested Activities: Grade(s) 11-12

Title: Resultant of a System of Vectors

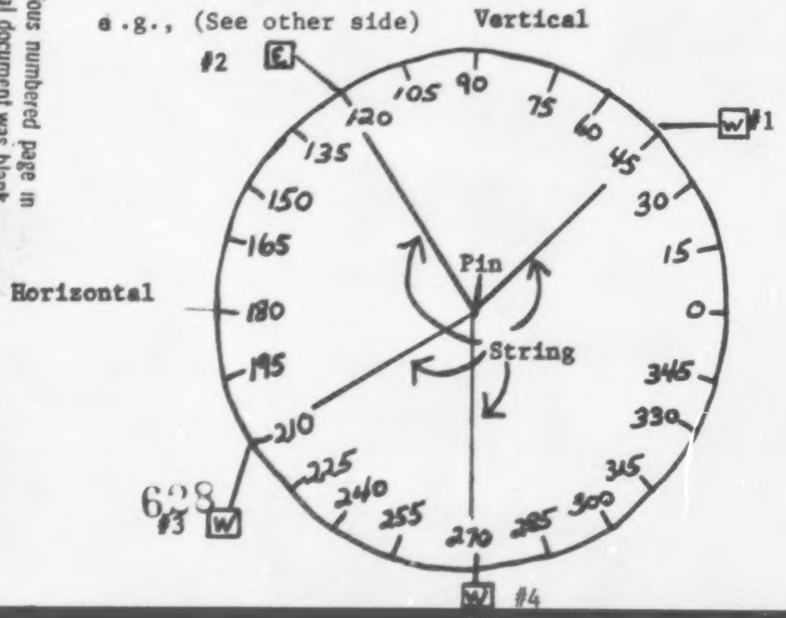
Group Size: four students

Materials: force board, string and weights

Procedure(s):

- Use a force board with 360° marks at edge. Hang 4 weights with string over edge from center ring at various intervals.
- Students calculate component displacements of each weight and predict the movement of the system when the pin is removed - based on their calculated sums of component displacements.

e.g., (See other side)


Vertical
#2
E
105
90
75
60
45
W
#1
120
135
30
150
15
165
Pin
Horizontal
180
0
String
195
345
String
330
210
225
315
240
255
270
285
300
#3
W
W
#4

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Suggested Monitoring Procedures

Teacher observation.

Possible Resources

District Resources

Suggested Activities: Grade(s) ______

Suggested Monitoring Procedures

Possible Resources

Use weight = 10 components

#1 horizontal: $\frac{h}{10} = \text{Cos } 45^\circ$

$h = 10\frac{\sqrt{2}}{2} \doteq +7$

vertical: $\frac{v}{10} = \text{Sin } 45^\circ$

$v = 10\frac{\sqrt{2}}{2} = +7$

#2 $\frac{h}{10} = \text{Cos } 120^\circ$

$h = 10\ (-\tfrac{1}{2}) = -5$

$\frac{v}{10} = \text{Sin } 120^\circ$

$v = 10\frac{\sqrt{3}}{2} \doteq +8.6$

#3 $\frac{h}{10} = \text{Cos } 210^\circ$

$h = 10\ \frac{-\sqrt{3}}{2} \doteq -8.6$

$\frac{v}{10} = 10 \text{ Sin } 210^\circ$

$v = 10\ (-\tfrac{1}{2}) = -5$

District Resources

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows that vectors are directed line segments used to represent quantities having magnitude and direction. B. The student knows the definition of displacement of a vector. C. The student is able to determine the resultant of a system of vectors both graphically and algebraically. (Continued)

Related Area(s)

State Goal	1
District Goal	
Program Goal	2,6,7

Suggested Activities: Grade(s) 11-12	Suggested Monitoring Procedures	Possible Resources

(Continued)

#4 $\frac{h}{10} = \cos 270^\circ$

$h = 10\ (0) = 0$

$\frac{v}{10} = \sin 270^\circ$

$v = 10\ (-1) = -10$

Resultant

Components: Horizontal:

$$\begin{array}{r} +7 \\ -5 \\ -8.6 \\ 0 \\ \hline -6.6 \end{array}$$

Vertical:

$$\begin{array}{r} +7 \\ +8.6 \\ -5. \\ -10. \\ \hline +\ .6 \end{array}$$

Therefore system will move in an ordered pair direction of (-6.6, +.6). The angle will have a tangent $= -\frac{.6}{6.6} \doteq -.0909$

Angle will be approximately $174^\circ\ 50'$

Remove the pin and check result.

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources
634		635

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

History of Mathematics

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. factors contributing to the development of numeration symbols (numerals) and number systems.		11-12					
. that modern mathematics has origins in early civilizations (e.g., Babylonian, Hindu, Egyptian, Greek, and Roman).							
The student is able to:							
. trace the development of positional number systems.							
. state contributions of certain outstanding mathematicians (e.g., Archimedes, Euclid, Pythagoras, Newton, Leibnitz, Pascal.							
. state reasons for the development of deductive mathematical systems in contrast to systems based on observation and experimentation.							
. cite recent studies and findings that shed new light on the nature or uses of mathematics in prehistory.							
The student values:							
. the central role of mathematics in technological advances throughout history.							

Suggested Objective Placement ________

Student Learning Objective(s) ______________________________

State Goal	☐
District Goal	☐
Program Goal	☐

Related Area(s) ______________________________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: ADVANCED TOPICS

Calculus	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. concepts of real numbers, analytic geometry and functions.		11-12					
. the definition of limit and can apply it to define differentiation.	401						
. the definition of continuity.							
. relationship between the derivative and the slope of a function.							
The student is able to:							
. solve inequalities with absolute value using the properties of real numbers.							
. evaluate the limit of an expression.							
. use the rules of differentiation to differentiate algebraic and transcendental functions.							
. apply differentiation to graphing, related rates and extreme value problems.	401						
. use limits and series to define integration.	403						
. use the formulas of integration to integrate algebraic and transcendental functions.							
. solve area, volume and length problems by using the various methods of integration.							
. solve problems of a physical nature such as work, mass, liquid pressure, etc., by using techniques of differentiation and/or integration.							
The student values:							

Suggested Objective Placement 11-12

Student Learning Objective(s) A. The student knows relationship between the derivative and the slope of a function. B. The student is able to apply differentiation to graphing, related rates and extreme value problems.

State Goal 1
District Goal
Program Goal 2,4,6

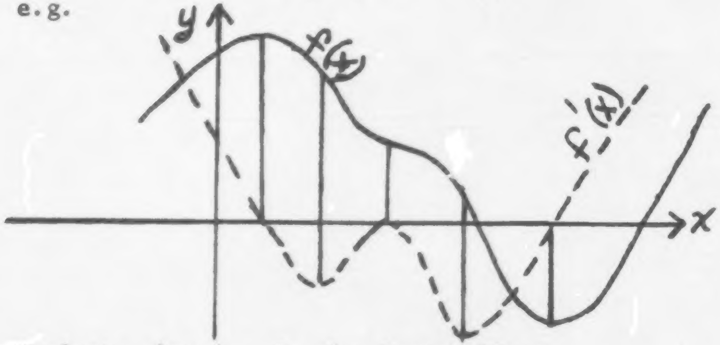
Related Area(s)

Suggested Activities: Grade(s) 12

Title: First Derivative
Group Size: entire class
Materials: Worksheets of graph of arbitrary f(x)

Procedure(s):

- Using a graph of some arbitrary f(x) have students sketch the graph of f'(x) e.g.



- Students sketch in the dotted line.
- Have student indicate extremes and points of inflection with vertical lines.

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Suggested Monitoring Procedures

Teacher Observation

Possible Resources

Analysis of Elementary Functions

Sorgentrey and Beckenbach
Houghton Mifflin, 1974

District Resources

Suggested Activities: Grade(s) _______	Suggested Monitoring Procedures	Possible Resources
		District Resources

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Suggested Objective Placement 11-12

Student Learning Objective(s) The student will be able to use limits and series to define integration.

State Goal	1
District Goal	
Program Goal	2,4,6

Related Area(s)

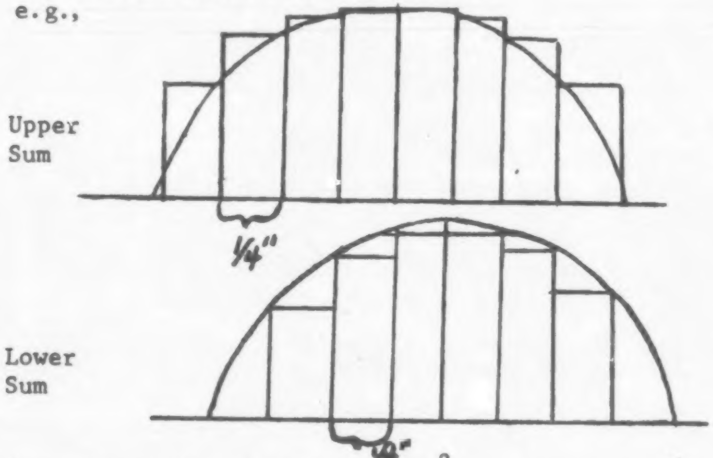
Suggested Activities: Grade(s)

Title:
Group Size: entire class
Materials: Ruler, worksheets of 2" semi-circles

Procedure(s):

- Using rulers and ditto sheets of semi-circles, r = 2 inches, have student calculate the area under each curve with intervals of ¼" of alternating upper and lower sums.

e.g.,



Compare results with $A = \frac{1}{2}\pi r^2$

Let students insert their own choice of smaller intervals.

Suggested Monitoring Procedures

Teacher Observation

Possible Resources

A First Course in Calculus, Including Analytic Geometry

2nd Ed., Lynch. Ginn, 1974
Page 134

District Resources

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTER TOPICS Computer Literacy / Computer Hardware / Flowcharting	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. that there are many computer-related jobs.		11-12					
. the function of each of the keys on a standard computer input terminal.							
. the distinguishing characteristics of an electronic digital computer.							
. some of the advantages of use of computer systems over other systems of treating data.							
. some of the limitations of computers.							
. that many electronic devices contain computers.							
. some positive and negative ways in which computers affect people.							
The student is able to:							
. turn on a standard computer input terminal and to log on and off a computer.							
. determine when solutions to given problems would most efficiently be helped by a calculator, personal computer, or large computer system.							
. run a "canned" program on the computer.							
. draw and interpret the shapes used in flowcharts.							
. construct a flowchart defining a common everyday activity (e.g., dialing a telephone).							
. construct a flowchart as a step in writing a program to solve a problem.							
The student values:							
. both the power and the limitations of the electronic digital computer.							

Suggested Objective Placement ________

Student Learning Objective(s) ________ State Goal ☐

________ District Goal ☐

________ Program Goal ☐

Related Area(s) ________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

The previous numbered page in the original document was blank

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: COMPUTER TOPICS

BASIC Language / FORTRAN Language

	Page	Suggested Grade Placement	District Placement 8	9	10	11	12
The student knows:							
. the elements of the BASIC language.		10-12					
. the BASIC language has limitations, and the advanced languages (FORTRAN, COBOL) are necessary for certain computer jobs.							
The student is able to:							
. write, execute and debug a BASIC program.							
. write, execute and debug a FORTRAN program.							
. trace programs written in BASIC or FORTRAN.							
. collect and organize data in a way that will facilitate solutions to a problem by computer.							
. distinguish between real and integer mode variables and will know the results of operations in these modes.							
. demonstrate proper application of accepted programming techniques.							
The student values:							

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Suggested Objective Placement ______

Student Learning Objective(s) ______

State Goal	☐
District Goal	☐
Program Goal	☐

Related Area(s) ______

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project.		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources
		District Resources

SMALL SCHOOLS PROJECT

SUBJECT: MATHEMATICS

SPECIFIC AREA: GENERAL STUDY TECHNIQUES

	Page	Suggested Grade Placement	District Placement				
			8	9	10	11	12
The student knows:							
. terminology, syntax and symbols pertinent to mathematics.		9-12					
. there are logical sequences to problem solving.							
. explanations and story problems must be read carefully at a slow rate, and then reread.							
. a study technique such as SQ, RQ, CQ may help clarify problems.							
The student is able to:							
. follow directions to solve problems.							
. identify relevant and irrelevant details in problems.							
. read and understand charts, graphs, tables and diagrams.							
. translate prose into mathematical sentences.							
. translate mathematical sentences into prose.							
. estimate and predict solutions.							
. determine what was asked for in a problem.							
. employ multiple strategies to solve problems.							
. check final answers against estimates.							
. carefully check computations.							
The student values:							
. mathematical insight in problem solving.							

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Suggested Objective Placement ________

Student Learning Objective(s) ____________________ State Goal ☐

____________________ District Goal ☐

____________________ Program Goal ☐

Related Area(s) ____________________

Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Possible Resources
No activities have been written for these objectives. Additional activities may be developed during the pilot phase of the project		
		District Resources

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Suggested Activities: Grade(s) ______	Suggested Monitoring Procedures	Suggested Resources

District Resources

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9-12 Mathematics

ANNOTATED BIBLIOGRAPHY

Beardslee, Edward C. and Max E. Jerman, Metric Measurement (a handbook for educators), Olympia, State Office of Public Instruction, 1978.

Included for the classroom teacher is a sequence of exercises and suggested activities for introducing and developing the metric system of measurement. Also included are suggested student projects, criteria for selecting metric materials and some available resource materials. The last section is intended to be used as a reference for general information on the metric system.

To get information and copies of this write to Dr. Monica Schmidt, Assistant superintendent, Division of Instructional and Professional Services, State Superindendent of Public Instruction, Old Capitol Building, Olympia, Washington 98504. (no charge)

Beardslee, Edward C., Funtastic Calculator Math, Enrich Ins., California, 1978.

A book of Reproducible Activities, Games and Experiences that challenge minds and motivate math interest. Good uses for calculators and possibly some pages can be used without calculators, Tear-outs for easy reproduction.

To get a copy write to Enrich Inc., 760 Kifer Road, Sunnydale, Ca. 94086. Also available at Learning World and Academic Aids in Bellevue, Seattle.

Historical Topics for the Mathematics Classroom, Thirty-first yearbook. National Council of Teacher of Mathematics.

To obtain a copy write the National Council of Teachers of Mathematics, 1201 Sixteenth Street N. W., Washington, D. C. 20036.

This book includes not only usable historical materials but also some indication of how they may be used by the teacher or student. The book is directed to the student and teacher in the classroom in many areas of high school math.

Brandes, Louis Grant, Math Can Be Fun, Portland, Maine, J. Weston Walch, 1975

This book includes an extensive collection of Puzzles, Tricks, Games, Stories, Illusions, and problems of a recreational nature. Also included are projects and recreational objective tests.

To obtain this book write to J. Weston Walch, Publisher, Portland, Maine 04104 and ask for Math Can Be Fun.

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Volume 1: Provides supplementary materials for beginning algebra students. The student solves various types of puzzles including cross number puzzles, codes, line designs picture graphs, and scrambled words, making the necessary practice in algebra an appealing experience.

Volume 2: Provides supplementary materials for second year algebra and trigonometry students of varying ages and abilities. The student solves various types of puzzles including cross number puzzles, codes, line designs, and potical illusions.

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